THE

ELECTRICAL REVIEW.

VOL. XCI. SEPTEMBER 8, 1922. No. 2,337.

ELECTRICAL REVIEW.

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THERMS—AND THE GAS BILL.

THE rain of complaints respecting the increase in gas bills since the new system was introduced of charging the consumer upon the basis of the heat units "declared" by the Gas Company to be contained in the gas supplied, has now assumed the character of a veritable cloudburst. It is a reasonable inference that some legitimate grounds must exist for such well-nigh universal dissatisfaction. It cannot be adequately accounted for by the suggestion of the secretary of the Gas Light & Coke Co. that owing to special circumstances the June quarter meter readings this year cover a period of 100 days and the March quarter 80 days in many cases, because many consumers report the doubling and even trebling of the June quarter's bill this year compared with the same quarter of 1921. The gas companies have attempted various other explanations, and for some days past a sort of apologia, or manifesto, entitled "Truth about Therms," has been published in the leading newspapers by the South Metropolitan Gas Company.

Attention is drawn therein to the fact that originally gas was used solely as an illuminant; that with the introduction of the incandescent burner, the luminosity of the flame became less important than its heating power; that, as a consequence, it is more logical to base the charge for a supply of gas upon its heating value; and that since September, 1920, gas has been charged for at so much per therm (100,000 B.th.u.) and not at so much per 1,000 cubic feet. It is pointed out that owing to the many possible sources of variation in the heating value of a gas, a "declaration of quality" has been made by gas companies, and that in London the declared values are:—

South Metropolitan Gas Company	560	B.th.u.
Gas Light & Coke Company	500	,,
Commercial Gas Company	475	,,

The manifesto then goes on to say: "If a similar volume of gas were taken from the mains of each company mentioned, in one case it would raise, say to boiling point, 560 gallons of water; in another, 500; and in the third, 475. This shows how unreliable it is to speak only in terms of cubic feet."

The *arithmetic* in the above statement is quite correct, but no reference is made to the influence exerted by the degree to which complete combustion of the gas is approached, upon the volume of gas registered by the meter in effecting the rise in temperature of these quantities of water respectively. This is not a mere academic point. It is of the essence of the whole matter.

All modern appliances for heating, cooking, or lighting by gas burn a *mixture of air and gas*. The air supply to the burners is, in general, fixed. The complete combustion of the gas (*i.e.*, the effective use of the declared heating value) can therefore only be attained if

the gas be of a certain presupposed quality and supplied to the burner at a certain presupposed pressure. Those who use the incandescent gas burner for lighting will readily appreciate the delicacy of the adjustment of the proportions of air and gas for efficient luminosity (*i.e.*, efficient heating effect). The same thing applies to the burners of the gas heater and gas cooker, but, whereas the eye can easily detect a faulty mixture of air and gas in the incandescent burner, it is impracticable readily to discern a disproportion of air and gas in the burners of the heater or cooker, and in proportion as the combustion of the gas becomes incomplete, so will the number of heat units liberated per cubic foot of gas consumed decrease, and the cooker will take a longer time to effect its purpose. Not only therefore will more cubic feet of gas be consumed to roast a joint—or whatever it may be that has to be cooked—but with the lowering of the efficiency of combustion, the number of therms charged for will become increasingly disproportionate to the actual number liberated and doing useful work.

Now, it is impossible, of course, that heating and cooking appliances can work equally efficiently with gases of different calorific values. Further, if the cook has become accustomed to use the gas cooker for x minutes to grill a chop and for y minutes to roast a joint, she will continue to keep the cooker alight for the same period of time in each case whether the calorific value of the gas be 475 or 500 B.th.u., and it is scarcely to be expected that upon the increase of the declared value from 475 to 500 B.th.u. she would alter the time of grilling her chop or roasting her joint to 0.95 x and 0.95 y minutes respectively, nor, indeed, is it likely that any economy arithmetically attributable to an increase in the calorific value of the gas would be fully realisable in practice.

With the vast expansion of the employment of gas for heating and power, the difficulty of maintaining a constant pressure throughout the distributing system has certainly not diminished, and owing to the fluctuations in demand throughout the 24 hours, appreciable variations in the gas pressure at the consumers' meters at many points are unavoidable, and constitute a not unimportant contributory factor to the inefficient action of gas cookers and heaters, and to the increase of the gas bill.

In a letter from Dr. Charles Carpenter, of the South Metropolitan Gas Company, published by the *Daily Mail* on July 29th last, this authority frankly writes: "The present trouble is not due to the therm, but to the fact that in not a few instances the price charged for it has been too high." Open confession is good for the soul. It is scarcely to be wondered at that consumers are complaining at the amount of their gas bills when, added to the causes which we have above outlined, it is admitted that the value of the therm has been overestimated.

It has long since been pointed out in these columns that if one Board of Trade unit of electrical energy is consumed in an electric heater, 3,410 B.th.u. are inevitably liberated, whereas, if a cubic foot of gas is burnt in a gas-heating appliance, no one knows exactly how much heat energy has thereby been obtained.

We may perhaps usefully draw our readers' attention to a clause inserted by the Board of Trade in the various orders of the gas companies:—

"If and so often as the undertakers shall alter the declared calorific value of the gas, they shall at their own expense effect such alteration, adjustment, or replacement of the burners in consumers' appliances as may be necessary to secure that the gas can be burned with safety and efficiency, except in the case of any consumer who objects to such alteration, adjustment, or replacement as aforesaid."

This provision is eminently reasonable. Clearly, if the consumer is to be charged for *heat units* upon the indications of a meter that measures *cubic feet*, he is certainly entitled not only to expect that every cubic foot registered by his meter does, in fact, contain the number of heat units upon the basis of which his gas bill is computed by the company, but that the efficiency of his gas-consuming appliances shall be restored by the gas company if, owing to any change in the quality of the gas, or in the conditions of supply, the efficiency of such appliances is adversely affected.

It is immaterial whether the price of gas be computed on the basis of the number of cubic feet, or the number of thermal units per cubic foot. What *is* material is that the consumer be safeguarded against any modification in the conditions of supply which operate to increase the disproportion between what he pays for and what he gets.

The E.P.E.A. Schedule.

Elsewhere in this issue we give a summary of the points with regard to which the two sides of the National Joint Board have this week been in negotiation. The situation is somewhat involved, and a close study of it is necessary if one would gain a true appreciation of the difficulties of the position. A comprehensive set of revised conditions of employment and an amended schedule of salaries have been put forward by the employers' side of the Board, which are intended completely to supersede the existing conditions and schedule; it is important, therefore, to consider not only what the new proposals contain, but also what is omitted from them, in comparison with the terms of the original agreement.

The principal changes appear to relate to the Schedule of salaries, the basis of classification, and the grading of employés. On the surface, it would appear that no drastic change had been introduced in the Schedule; the range between 4,000 kW and 30,000 kW has been distributed between the four classes in a new ratio, but the remaining classes are unaltered. The effect of this proposal would be that a considerable number of men would be transferred to a class one stage lower than they are in at present, and a small proportion would be moved down two classes.

The change proposed in the basis of classification is to substitute for the total capacity of the generating plant one of two alternatives (whichever results in the lower classification), namely, the "normal continuous rated output" or the maximum demand for one hour, plus 25 per cent. Either of these bases may obviously differ considerably from the existing basis, and in general one or other certainly would fall much below the former. It will be seen that this proposal also tends to lower the position of a generating station in the classification, and consequently would further reduce the salaries of the staffs below the present values, aggravating the loss in the case of stations falling within three of the classes, and affecting many of those in the other classes. These two changes are cumulative in their effect, and may easily result in a reduction of salary of 10 or 20 per cent. basis.

But the third important change that we have mentioned is perhaps the most serious of all—for it consists in the *total omission* of any basis of grading whatever. Obviously a schedule based on grading becomes farcical when the grading is abolished. So grave an omission could not possibly be due to an oversight; it will be absolutely fatal to any prospect of agreement, and we earnestly appeal to the employers to think twice before they press their emasculated schedule upon the engineers. The essence of the existence of the Joint Board is to endeavour to solve all such questions by agreement and peaceful negotiation; but agreement to return to the chaotic conditions and the miserable remuneration which disgraced the industry of electricity supply before

—aye, and throughout—the war is impossible. If these proposals are pressed without material modification, the cause of peace will be jeopardised, and a heavy blow will be struck at the Whitley system, which has worked so well in the past and from which we hope so much in the future.

That power station engineers have been far more contented and at rest since the Schedule was adopted than before, is undeniable; that they are entitled to justice and consideration is equally unquestionable; and lastly, that they have acquired strength by combination—but have used it with discretion and moderation—is a matter of historical fact. We hope that the employers' representatives will give due weight to these considerations and refrain from provoking a conflict in a key industry, at a moment when we are all looking forward hopefully to improvement in trade and reduction of unemployment.

Broadcast Wireless Telephony.

The inauguration of the broadcast wireless telephony scheme seems to be as far off as ever. Meanwhile, the wave of enthusiasm amongst amateurs will in all probability be damped down by the delay. It is no doubt sound policy to launch a new scheme just when public interest has reached its crest, but one must beware of toppling over that crest and being drowned in the trough that always follows a wave, no matter of what sort.

The causes of delay are several. There was the initial difficulty of formulating an agreed scheme among the manufacturers of wireless apparatus, but several weeks have elapsed since the formation of the British Broadcasting Co. was announced. Its proposed articles of association have been in the hands of the Post Office authorities for nearly three weeks, but they have not yet been officially approved of.

With no precedents to guide them, except the utter confusion which has occurred in the United States consequent on the haphazard manner in which broadcasting has been indulged in there, the authorities rightly desire to scrutinise as closely as possible the conditions under which broadcasting will be allowed in this country—the articles of association must be brought into alignment with the general principles with which the Postmaster-General expects the company to conform.

Several important points are, however, still outstanding, one being the conditions under which broadcast matter should be reproduced in public places of entertainment. It is contended that such entertainments should provide a substantial contribution towards the expenses, which have been estimated at £20,000 per annum for each of the several transmitting stations that it is proposed to erect in various parts of the country, and which will not be fully met out of the percentage the Postmaster-General proposes to allow on each receiving licence issued.

Moreover, a fresh obstacle appears to have been encountered. Within the last fortnight, according to *The Times*, the manufacturers have reconsidered several points and have submitted a fresh series of articles of association which differ materially from their original proposals—modifications that may be expected to postpone still further the inauguration of the scheme.

Another aspect that is causing some concern is the Postmaster-General's agreement with the manufacturers that for two years after the inauguration of the scheme, licences shall only be granted in respect of apparatus manufactured by members of the Broadcasting Co.—a protective regulation directed against the importation of foreign apparatus with which British firms are apparently unable to compete on a price basis. But it should be pointed out that in order to avoid a monopoly, it is stipulated that any *bona fide* British manufacturer can become a member of the Broadcasting Co. by the purchase of a £1 share. In all probability, *The Times* is officially informed, this protective measure will not affect owners of home-made sets already in use, nor sets constructed for *bona fide* experimental work in the future. Nevertheless, the mere purchase and assembly of component parts with no other purpose in view than the reduction of the cost of "listening-in" will be regarded as an evasion of the regulations. "We are obliged to do this in order to get some sort of income for broadcasting," a Post Office official is reported by *The Times* to have said, but such a regulation will obviously be difficult to administer, and its justice is doubtful. The type of message that it is apparently proposed to transmit broadcast will only appeal to the amateur who in the vast majority of cases has no inclination, if indeed he has the means, to purchase an expensive receiver. It is the novelty of the thing which appeals to the general public, and the success of the scheme would therefore appear to depend on the cost of purchasing and installing a receiving outfit being kept as low as possible.

Railway Accidents and Research Work.

The terrible accident at Gravesend which recently formed the subject of an official inquiry presents—from the point of view of a signal engineer—no new feature. The evidence adduced was practically a repetition of that given at other inquiries in the past, touching the cause of previous similar disasters. It retold an old and oft-repeated story of one train being unexpectedly prevented from running according to the time-table and a following train crashing into it—in spite of the protective signal. As usual, the cabinman swore that this signal was "on," while the driver swore that it was "off."

A standard text-book on Railway Engineering states that "Two solid bodies cannot occupy the same space at the same time; and that the duty of a railway signalling engineer may be said to be to endeavour to prevent two bodies which are moving at high velocities from seeking to violate this law of Nature."

Writing to us on this subject, Mr. A. E. McCloskey, a member of the Institute of Railway Signal Engineers, points out that in America there is a "Safety Board" which examines and develops new ideas for the prevention of railway accidents. In England such a Board is unfortunately still an unfilled want, as is shown by the following case: A Colonial railway engineer brought a new patent to the notice of the Minister of Transport, who informed him that the selection of systems of railway signals was practically left to the individual discretions of the general managers. After much correspondence and delay, the Colonial engineer succeeded in obtaining an interview with a general manager, who said that he was sorry no funds were available for experimental work, but he would be very pleased to go into the matter again if and when the invention had proved successful—*on some other railway*. But the inventor's leave of absence had expired, and the benefit of his new invention was lost to the State.

At a recent inquiry the Attorney-General asked whether the War had had the effect of apparently lessening the value of human life in the eyes of public carriers and their subordinate officials; and in a paper read before the Institution of Civil Engineers the author made the following significant remarks: "Signalling improvements have not been, curiously enough, generally introduced until the stipulated number of years of life of the various patents have elapsed. Although this may appear a strange coincidence, yet it can be accounted for by the general hesitation of managers and other responsible officers to enter upon what appears to them to be an experiment or new departure."

The Medical Association recently replied to a well-known philanthropist who had offered £10,000 as a prize to anyone who could discover a cure for cancer, that what was really required was not a "prize" but a fund to provide food and clothing for the scientists while they were engaged on the scientific research work, necessary to the attempt.

And in the case of the repeated fatalities on our railways the parallel is obvious. Under present conditions no one can afford to do scientific research work.

D

NOTES ON THE ELECTRIFICATION OF THE YENANGYOUNG OIL FIELD.

There are few industries which have attracted more general attention during recent years than that devoted to the recovery of petroleum. The rapid increase in the use of mechanically-propelled road vehicles, the application of oil fuel for ship propulsion, the advance in Diesel engine design, and the startling developments in aerial craft have stimulated this interest and impressed the mind of the public with the importance of the oil industry in their own lives, and the big part it plays in our modern civilisation.

Unfortunately the supplies of crude oil are not inexhaustible. There is much speculation and doubt regarding the life of existing fields if the recent increase

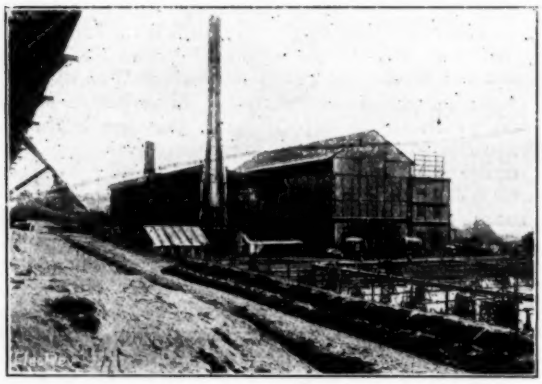

Fig. 1.—Power House, Approaching Completion.

in the rate of demand continues, and any considerable diminution in the supply of oil would be hardly less than catastrophic at the present stage of the world's material progress.

The situation calls for increased attention to the economical operation of the fields themselves. The recovery of crude oil in the past was generally effected with little regard for this point, and the percentage of oil consumed to oil recovered was iniquitous, in view of the potential value this oil possesses to-day.

It would have been natural to expect that electricity would have been brought early to the aid of the industry in this connection, but it has been slow in making headway, and has only embraced the standard cable tool system of winning the crude oil within comparatively recent times. Most engineers are familiar with the prejudices that in the past proved an obstacle to the development of electricity in coal mining. The situation of the oil industry has been somewhat similar; the supplies of fuel were seemingly unlimited, and the prodigal waste of crude oil was overlooked, or deemed of little importance, in view of the profits a successful company made. Indeed, there was some justification of the oil owners' former attitude because the ordinary industrial motor was in many cases not found suitable to the varied requirements of oil field operation. This situation is now rapidly changing. The problem of adapting the electric motor for pumping and drilling purposes has been successfully overcome, and to-day there are some thousands of electrical equipments installed on various fields.

A most interesting and notable recent development in the application of electricity to the petroleum industry is the power scheme which the Burmah Oil Co. are inaugurating on their Yenangyoung Field. This oil-bearing territory has been one of the most prolific for its size in the world, and has suffered in common with other fields from uneconomical methods in the past. The conversion of all wells to electrical drive was first studied in 1910. At that date—in this field as unhappily still to-day in the bulk of the oil fields of the world—the pumping and drilling plant consisted in the main of some hundreds of small relatively inefficient steam, and to some extent gas, engines, the steam engines being supplied with steam from numerous unlagged portable boilers burning crude oil fuel, and sometimes natural gas. The steam piping, often of considerable length, was generally unlagged also. It needs no figures to demonstrate how wasteful this system was. The important economies and valuable conservation of oil which could be effected by replacing these small steam units by central station plant, designed on modern lines, were apparent. The problem of converting this plant at that date was, however, not without its difficulties, and it was evident from the outset that the mere substitution of the ordinary industrial motor for the steam engine would not meet the requirements of the oil well operators, particularly as the standard cable tool system of petroleum recovery was in use on this field.

It was about the same date that the problem was being seriously tackled on some of the American oil fields, where the conditions of operation were very similar. After considerable experimental work, and largely due to the enterprise of the General Electric Co., of Schenectady, and the Westinghouse Electrical Co., of Pittsburg, a type of motor was eventually evolved which met all the requirements of oil well work, both for drilling and pumping purposes. A small trial installation was supplied to the Burmah Oil Co. in 1914, and the results, both with drilling and pumping equipments, were so satisfactory that the directors decided to accept the principle and immediately set about the conversion of the whole of their wells in the Yenangyoung Field to electrical operation. This important project was held up due to the outbreak of war, but as soon as peace was re-established, matters were put in train and the scheme is now approaching completion.

The Yenangyoung Oil Field is situated on the east bank of the river Irrawaddy, approximately 300 miles from its mouth. The area of the field actively producing is only two-and-a-half miles long by half-a-mile in

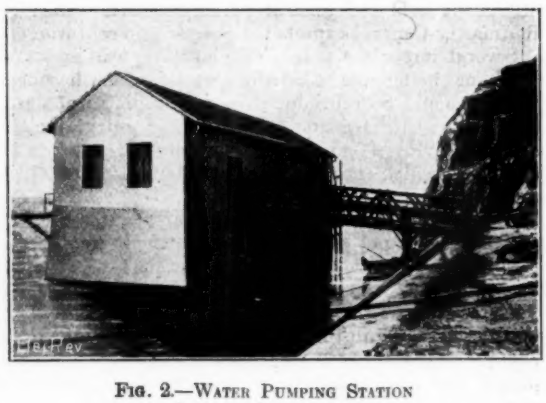

Fig. 2.—Water Pumping Station

width. In this area there are, at the present date, approximately 1,000 wells belonging to various oil companies, a number of workshops, auxiliary pumping plants, and the miscellaneous apparatus attendant on any large industrial scheme. At present the motive power on the field is obtained from small steam or gas engines as described above.

With a view to providing electrical power for the operation of this field, the Burmah Oil Co. have erected a power station at a place called Thittabwe, about two-and-a-quarter miles distant, and in close proximity to the river. Fig. 1 shows the first installation of the power station buildings approaching completion.

Engine-room and Annexe.—The engine-room and switchgear annexe are steel structures filled in with concrete blocks.

The station is being equipped with four 4,000-kW, 6,150-kVA, three-phase, 50-cycle turbo-generator units generating at 3,300 volts and four 6,150-kVA oil-cooled transformers for stepping-up the machine pressure to 13,200 volts. The transformers are placed in separate compartments, and are tied to the machine terminals without the intervention of any switchgear, so that the turbo-generator and transformer form virtually one unit. The 13,200-volt terminals of the transformers are coupled to switches mounted in moulded stone

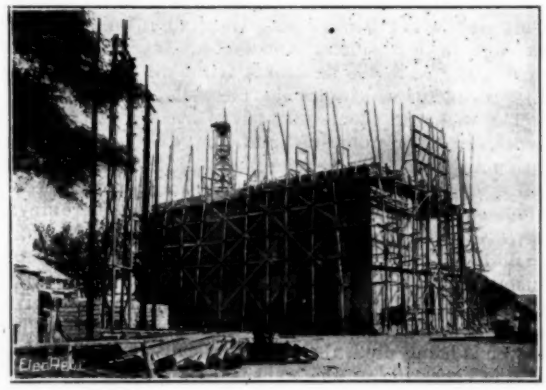

Fig. 3.—Main Receiving Sub-station, in Course of Construction.

cubicles built in an annexe of the engine-house. The switchgear is arranged in two tiers: on the first floor the cubicles contain the h.t. switching apparatus, current and potential transformers; and on the second floor are the busbar chambers, busbar isolating switches, &c. The board is arranged with duplicate busbars, each set of busbars being carried in its own separate compartment. All the switches are electrically operated from a control board of the usual bench-board design, which is situated on the second floor overlooking the engine-room.

There are two 13,200-volt outgoing feeders for the supply of energy to the oil field, each of the overhead split conductor type. In addition, duplicate outgoing h.t. feeders of the plain type provide for the local requirements of the Burmah Oil Co. at Nyaunghla. Provision is also made for additional feeders of the same description should the developments of the scheme in the future require it. All outgoing overhead feeders are protected by oxide film lightning arresters, and are carried through the roof of the annexe building by means of special porcelain roof bushings. The conductors are carried from these bushings to a specially designed steel roof structure, and from thence to the various transmission line towers.

The turbo-generators exhaust to low level jet condensers, placed in the basement immediately below the turbines. The condenser cooling water is drawn from a culvert running between the engine-house and boiler-house. This culvert leads to a large storage and settling tank at the north end of the building. Under normal operating conditions this tank will be supplied with water from the river by means of two electrically-operated 14-in. centrifugal pumps, having a capacity of 5,000 gallons per minute, placed in a pumping station on the river bank, fig. 2; it will function mainly as a means of settling the fine deposit which is carried in suspension in the river water. Owing to the vagaries of the river, however, it may prove difficult to pump the required amount of water during a low-water period, and if this contingency arises, provision has been made for utilising the tank as a spray cooling pond during such time as water is unobtainable from the river in sufficient quantity.

Boiler-house.—The boiler-house is a steel structure covered with corrugated sheets. The present plant consists of four Babcock & Wilcox land type water-tube boilers, each capable of evaporating 30,000 lb. of steam per hour under normal duty, or 37,500 lb. of steam under overload conditions. (Two additional boilers of the same capacity and design are now on order, so that the completed plant will consist of six units.) The boiler pressure is 200 lb., and the steam is superheated to a total temperature of 650 deg. F. by means of superheaters integral with the boilers.

Each boiler is provided with 12 oil fuel burners designed on the pressure atomising system, and also 12 gas burners for burning natural gas. It is anticipated that under normal working conditions, the natural gas obtainable on the field will supply all the requisite fuel at the present time.

Each boiler operates in conjunction with a Green economiser consisting of 256 tubes, and the gases from each pair of boilers are carried to a separate self-supporting steel chimney having an overall height of 150 ft. This chimney is provided with an electrically-operated induced-draught fan, which will be required when dealing with the maximum evaporation of the boilers, but it will be possible to operate under natural draught with a corresponding decrease in boiler output.

The pump room contains two steam-driven vertical Weir feed pumps, each capable of supplying 9,000 gallons of water per hour, and one electrically-operated turbine feed pump of Worthington-Simpson manufacture. There are also two Worthington steam-driven oil fuel pumps, each suitable for supplying oil fuel to three boilers at a pressure of 200 lb. per sq. in., and one electrically-operated pump of similar design and capacity.

Transmission Lines.—Electrical energy will be conveyed to the field by means of two transmission lines, each approximately 12,500 ft. in length. The lines are being conducted along separate routes, so as to avoid,

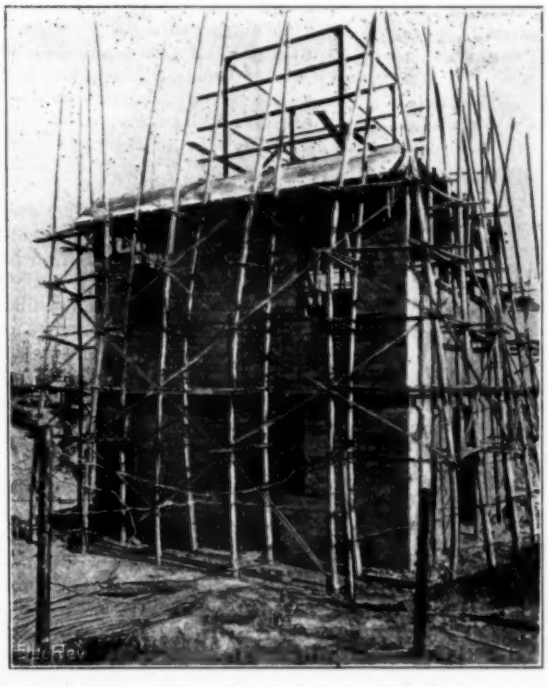

Fig. 4.—Typical Field Sub-station, under Construction.

as far as possible, the contingency of both being interrupted at the same time. In case of emergency, either transmission line will be capable of carrying the total load.

Each transmission line consists of six No. 0 B. & S. stranded wire conductors carried on galvanised steel towers built by Messrs. Milliken Bros. Ordinary pin type insulators are provided for the intermediate towers, but the line will be anchored by means of Hewlett strain type insulators at frequent intervals. An overhead stranded steel earth wire ⅜ in. in diameter will be

carried the whole length of the line. In order to avoid the interruptions which are liable to occur with an overhead split conductor system when birds cause a temporary earth to the cross-arms of the towers, the pin type insulators are raised considerably higher than is usual in ordinary transmission-line practice.

Main Receiving Sub-station.—The two transmission lines are run to a main receiving sub-station centrally situated on the western side of the field (fig. 3). This sub-station will act as a distributing centre for the whole of the oil fields, and is equipped with electrically-operated remote-control high-pressure switchgear of similar design to that provided in the power station. The building is a steel and concrete structure, and it will also serve as the headquarters of the field's electrical engineering staff.

High-pressure Ring Mains.—The main receiving station will feed two split conductor ring mains which encircle the more active part of the oil field. These ring mains will be tapped by 12 sub-stations, also confined to the outskirts of the field. Owing to the very congested nature of the oil well area, it was thought desirable to keep the entire h.t. system outside it.

The ring mains are carried across each sub-station on overhead steel structures which form a series of anchor towers. Alternate sub-stations will be tapped off different ring mains, and between every sub-station, split conductor protection will be provided. These ring mains are carried on galvanised steel towers of identical design to the main transmission lines, except that the cross-arms are extended so as to carry a total of 12 conductors instead of six. If any fault occurs on the ring main between any two sub-stations, it will result in this portion of the line being cut out automatically without interrupting the supply of energy to any of the sub-stations. Moreover, if either ring main were to fail in two places and thus interrupt the circuit entirely, the remaining ring main would still be capable of supplying energy to all the alternate sub-stations round the field, and by means of interlinking the low-tension distributors, a supply could still be maintained at every well. These unusually elaborate precautions have been deemed necessary in view of the paramount importance of maintaining a supply of energy on the oil field in all possible circumstances.

Sub-stations.—The sub-stations are rectangular steel structures approximately 26 ft. square, with 9-in. walls of concrete block or brick (fig. 4). They are built with two floors. The upper floor contains the h.t. cubicle switchgear and lightning arresters, and the ground floor the l.t. switchboard and transformers. At present each sub-station will be equipped with one 500-kVA, three-phase transformer reducing the line pressure of 13,200 volts to 460 volts for distribution on the field. Provision has been made for a second transformer of the same size, so that the ultimate capacity of each sub-station will be 1,000 kVA.

Low-pressure Distribution.—From each sub-station will radiate the low-pressure feeders providing actual energy to the individual wells, and to the auxiliary plant on the field. Each distribution feeder will consist of six No. 0000 B. & S. stranded copper conductors carried on 35-ft. Bates expanded steel truss poles. The conductors will be run two in parallel, and the length of each distribution feeder will be kept as short as possible. The provision of parallel conductors and the short length of the feeder has been rendered necessary in order to reduce the reactance of the low-tension system, and to provide reasonably close regulation at the motor terminals. Each sub-station will supply a comparatively small area, and under normal conditions the low-tension distributors will not be interconnected, so that if any mishap were to occur at any one sub-station, the portion of the field affected would be limited to a comparatively small area. Provision has been made, however, for coupling the low-tension feeders of one sub-station to the low-tension feeders of the adjacent sub-stations, so that in an emergency it would be possible to feed through. The service lines are tapped off the overhead distributors and conveyed to pole line oil switches mounted on the distribution poles. From the oil switches the service lines are carried to groups of two or three wells. In case of fire on the field it is possible to disconnect any individual service and make the line entirely dead. These service lines are carried on a similar design of Bates pole, somewhat lighter than that employed for the main distribution feeders.

Oil Well Equipments.—The actual service connection to the motor equipments is made by means of an insulated cable carried on porcelain insulators and brought into the motor-house through porcelain bushes. This service is taken to three ironclad fuses and thence through a three-phase unbalanced integrating wattmeter, and so to the terminals of the oil switch controlling the motor which operates the well.

The well equipments themselves are of two distinct types, *viz.*, for pumping and for drilling purposes. The pumping equipments consist of two-speed motors rated at 30/12 h.p., running at a synchronous speed of 1,000 or 500 r.p.m. The drilling equipments are single-speed machines rated at 75 h.p., running at 750 r.p.m.

Both pumping and drilling motors are designed and installed so as to reproduce, as closely as possible, the conditions which exist with the steam engine drive; thus, beyond the fact that a different type of prime mover is being used, there is practically no modification in the operation of the wells. This greatly facilitates the conversion and enables the present operators to become acquainted with the handling of the new plant with the minimum of difficulty. This remark applies particularly in the case of the drilling equipments. The controllers for varying the speeds of the motors are operated by means of a steel wire rope from the "headache" post of the rig in exactly the same manner as the throttle of the drilling engine—in fact, the driller might hardly know that he was not controlling the usual steam engine, as the motor plant is out of sight and he secures precisely the same results on his drilling line in the manner he has always been accustomed to.

The fact that each well, whether pumping or drilling, is provided with an integrating wattmeter will form a most valuable aid to the economical operation of the plant. In the case of a pumping well, it will be possible to determine accurately the stage at which the pumping becomes unremunerative. It is generally anticipated, and forms one of the arguments in favour of electrical operation, that it will prove remunerative to pump a well to a much greater degree of exhaustion than is possible under the existing system.

Miscellaneous Applications.—The economy which can be effected on an oil field such as Yenangyoung is not limited by the application of electricity to the wells alone. In the present instance electrical drive will also be employed on auxiliary plant of a very varied nature. The more important installations of this character are:—

1. The main line oil pumping station.
2. Water service to the fields and for domestic purposes.
3. The oil collecting and pumping stations on the field.
4. The various workshops.
5. Rope-way.
6. Ice-making plant.
7. Lighting and fans for bungalows, and
8. The actual illumination of the oil field area and individual rigs.

When the scheme is finally complete, all these services will derive their power from the main central station at Thittabwe, and numerous isolated boiler plants and small lighting sets will be superseded. This will form by no means an unimportant factor in the operating economy of the whole field.

It is worthy of note that the benefits of this very important project will not be confined to the Burmah Oil Co. alone. Although the Burmah Oil Co., Ltd., are providing all the capital cost and carrying the entire

risk of exhaustion of the field, they have invited and secured the co-operation of the numerous other oil companies who operate on the same territory, as co-operative consumers, the Burmah Oil Co. undertaking to provide them with electrical energy at cost *pro rata* between themselves and all other consumers. There is therefore no opportunity of rival supply schemes on the same field, which, in view of the small area and congested condition, would not only have made the engineering work much more difficult, but might have been a fruitful source of friction between the various oil interests concerned.

In conclusion, it should be stated that the whole of the power scheme described in these notes has been carried out by the Burmah Oil Co.'s own engineering staff in London and Burma, under the direction of Mr. C. McCarthy-Jones, M.I.Mech.E., M.I.E.E., consulting electrical engineer, London.

The chief contracts for the main plant were placed as follows:—

Main station buildings ...	Armstrong, Main & Co.
Boilers	Babcock & Wilcox, Ltd.
Turbo-generators and switch-gear	British Thomson-Houston Co.
Condensers and pumps ...	Worthington-Simpson, Ltd.
Transformers	The B.T.H. Co., Ltd., and International General Electric Co.
Oil well equipments	International General Electric Co.
Transmission line towers ...	Milliken Bros.
Cables	Callender's Cable & Construction Co., Ltd.

HIGHER STEAM PRESSURES OR PULVERISED COAL.

Under this title in a recent issue of the *Journal* of the American Institute of Electrical Engineers, a paper by Mr. F. A. Scheffler discusses whether for the boiler-house of a 10,000-kW power station it is likely to be more economical to operate the boilers at 250-lb. pressure and 600° F. total temperature or at 400-lb. pressure and 700° F. total temperature, and whether in each case it is cheaper to use mechanical stokers or pulverised coal. The author's association with the Fuller Engineering Co. of New York, which manufactures burners for pulverised coal, is clearly shown, but any risk of a charge that the advocacy takes the form of a strained special pleading is discounted by the frankness with which the various figures are put forward, no less than by the excellent manner in which, in an appendix, the boiler tests are scheduled.

The paper is mainly commercial, but before we look to the comparisons of capital outlay and running costs, it is best to refer to the appendix for figures of thermal efficiency. These results are in no degree abnormal—we cite some of the salient figures. The boiler was of the water-tube type, having a water-heating surface of 13,057 sq. ft. The durations of two tests exceeded 48 hours by 8 minutes and by 50 minutes respectively. The fuel was a powdered Illinois coal, of about 11,950 B.th.u. thermal value per lb. of dry coal, containing from 13.137 to 13.567 per cent. of ash and refuse per unit of dry coal:—

	Test No. 3 Average.	Test No. 4 Average.
Steam pressure, lb.	263.8	267
Temperature of superheated steam, ° F.	583.5	598.4
Equivalent evaporation per hour per square foot of heating surface from and at 212° F.	4.74	7.00
Thermal efficiency of boiler furnace and superheater, based on coal as received ...	82.8%	82.23%
Thermal efficiency of boiler furnace, superheater, and economisers based on coal as received	87.9%	88.38%

These efficiencies, while good, do not in any way suggest inaccurate optimism—indeed, we have known somewhat higher thermal efficiency with water-tube oil-fired boilers.

It is not so easy at this distance, in days of unstable prices, to certify as to the likelihood of accuracy of the author's estimates regarding the difference in the capital outlay on the boilers, economisers, steam pipes, turbines, &c., for the two conditions of 250 lb. steam at 600° F. and 400 lb. steam at 700° F. The author estimates this at 776,400 dollars, or $7.764 per kW of plant installed.

For stokers and accessories the author estimates a total capital outlay of 422,400 dollars, and for the pulverised coal-burning equipment and accessories a capital outlay of 476,000 dollars.

In arriving at operating costs as distinguished from fixed and maintenance charges, Mr. Scheffler assumes the following conditions:—

Turbine steam consumptions, 10.75 lb. per kWh for 250-lb. pressure, and 10.0 lb. per kW for 400-lb. pressure, plus in each case an allowance of 5 per cent. for additional power or steam for auxiliaries. In each case also the annual load factor is taken at 40 per cent., and the coal is assumed at 13,000 B.th.u., with 8 per cent. ash. This coal is taken at $5 per long ton. As regards boiler efficiency, this is assumed at 78 per cent. for the stoker plant and 85 per cent. for the pulverised coal equipment. (This seems the one point in the paper upon which further light is needed. We grant that under full-load conditions a thermal efficiency of 85 per cent. is easily conceivable for a boiler burning pulverised coal, but this is not nearly so conceivable when the average working load factor is down at 40 per cent., which means periods of easy steaming or the equivalent of banked fires.)

We omit the dozen or more items on which the daily costs are based, and, reciting the author's conclusions, give the daily totals:—

		Total daily costs.	Fuel costs only.
250-lb. steam pressure and 600° F. temp.	Stoker fired ...	$3273.80	$2928.00
	Pulverised coal fired ...	3032.20	2683.00
400-lb. steam pressure and 700° F. temp.	Stoker fired ...	3428.05	2810.40
	Pulverised coal fired ...	3162.07	2547.60

The author therefore concludes:—

(*a*) It will cost a great deal less money to equip and use pulverised coal in power plant in order to obtain the highest efficiency and the lowest operating costs than it would to use a high pressure of 400 lb. and high superheat of 700° final.

(*b*) That lower B.th.u. per kWh and high over-all thermal efficiency will be obtained by substituting pulverised coal-firing in lieu of any other known method using the moderate high pressure and superheat in common practice to-day, compared with high pressures and temperatures.

(*c*) That the benefits accruing from the net difference in station water rate between the present practice as to pressures and temperatures and the higher pressures and temperatures are comparatively small, and do not warrant the excessive additional first cost and yearly fixed charges for the higher pressures and superheat.

(*d*) That the cost per short ton of coal handled and burned by stokers in the 250-lb. pressure plant (exclusive of the cost of the coal) will be 52 cents, and with pulverised coal 58 cents. For the 400-lb. pressure plant this cost would be increased to 95 cents per ton with stokers, which increase is due principally to the additional fixed charges over the 250-lb. pressure plant.

International Road Congress.—The *Board of Trade Journal* states that the fourth International Road Congress will meet at Seville in May next year.

Among the papers to be presented are: "Laying Tramway Rails on the Various Kinds of Road Surface," by Mr. J. A. Brodie, M.Inst.C.E., City Engineer, Liverpool; and "The Problem of Traffic on Congested Roads and Streets of Towns," by Messrs W. Rees Jeffreys and A. E. Cave.

BAD BUSINESS.

By H. R. TAUNTON.

The electrical contractor is sitting in his office. He has been sitting there, off and on, for a year or more. Moss is growing on him in patches. To him enters a traveller. He has noted the empty showroom, the diminished staff knitting a jumper, the careworn creases in his customer's countenance as he sits moodily "writing down" his stock-list. "Business is bad here!" thinks he. So, knowing that nothing will please the contractor more, he assures him that business is bad everywhere.

"Haven't taken an order to-day. You're my last hope. Let me show you this new———."

The contractor brightens up perceptibly—though not often to the point of placing an order. Half a dozen more travellers come along and tell him the same tale; and by the end of the day he is comparatively cheerful. He almost chuckles as he reprices his ceiling roses at 2s. a dozen.

"General trade depression! It isn't as if I was the only one! Can't expect to get orders while business is so rotten—must just wait till things improve." And another little clump of fungus sprouts upon him.

He's quite right, of course, in saying business is bad. It is, for him and hundreds like him—such is the power of Monsieur Coué! And business is likely to remain bad until contractors scrape off the mildew and get out into the sunshine. In the words of the American poet, "He who woos success should have his eyes on the stars, his ear to the ground, and his nose on the grindstone."

The expression "Business is bad!" simply means that there is a scarcity of ready money in the community; so that the public, after spending so much on the essentials of existence, has only a relatively small surplus wherewith to buy non-essentials. But there *is* always a surplus. What it is spent on is a matter of individual taste, influenced by social environment, and the fashion of the hour. The dilettante spends his surplus on artists' proofs and first editions; the *bon viveur* on wines and cigars; one will buy a motor car or a pianola, and another furs and jewellery.

There is always plenty of money floating about to be spent on pleasure of one kind or another. Why should not some of it be diverted into electrical channels, to the benefit of contractors and the industry at large?

The price of a pianola would equip an electrical kitchen. That of a sable coat or a pearl necklace would cover the cost of an elaborate installation. But sables and so on are fashionable; electricity is not. The fault is that of the ill-organised electrical trade. Fashions can be made: they are largely the result of judicious publicity and subtle propaganda.

There are two possible ways by which some of the money in circulation can be switched into an electrical circuit: either by making electricity a fashion, so absorbing some of the surplus available for luxuries; or, better still, by making it a necessity, so that it taps the stream of expenditure before it dribbles away in non-essentials.

Let the manufacturers, factors, supply companies, and contractors co-operate in aggressive advertisement and salesmanship; let them educate the public to look upon electricity as a desirable luxury which should have first call upon their spare income. Make the electrically equipped home "the thing": so that Lady de Vere will be as ashamed of a gas cooker in her kitchen as she would have been, thirty years ago, of gas light in her drawing room: so that Mrs. Newrich, to be in the mode, must have electric radiators in every room: so that Suburbia will emulate Belgravia in electrical equipment, and "swank" in Board of Trade units.

Alternatively, if it be argued that electricity is too utilitarian ever to be fashionable, the public has still to be convinced of its utility; and the same advertising energy can be—and probably more usefully—directed to preaching electricity and its applications as necessities, essential to existence, or at least to comfort.

Electrical contracting should be one of the last businesses to be seriously affected by trade depression. One never hears the baker, in the worst of times, complain that business is bad. Bread is a necessity. So ought to be electricity. The remedy for bad trade is for it to be made a necessity by contractors and the industry at large.

Yesterday's luxury is to-day's necessity. Electric lighting, some thirty years or more ago, was the toy of a few rich men. To-day, millions of people in private houses, public buildings, shops and factories are dependent upon it as their only means of illumination. Lamps, at least, are a necessity to them; and, however bad be trade, a certain minimum of repairs. If the contractor nursed and educated his public properly, that minimum would be much larger, and not only repairs, but improvements and extensions would be considered indispensable.

To those who have once tried them, electric irons, kettles, and other domestic appliances are reckoned essentials to comfort. It should be the mission of the electrical contractor to make those who have not tried them do so. Obviously, the more people who are taught to regard certain articles as necessities, the more of those articles will be sold. The field of electrical appliances widens automatically every day; but contractors should not be content with "automatically."

In the Stone Age man ground his corn by hand. Later he trained animals, and harnessed wind and water to do his work. Later came steam, to be supplanted in modern times by the electric motor. Electricity is to-day the silent, but gigantic driving force of the world. If every electric motor in the country were to break down simultaneously, it is no exaggeration to say that industry would be paralysed. To keep them going means so much work for the contractor—if it is only to supply new brushes. More necessities.

In a sound contracting business the mainstay should be maintenance and repair work, small supplies and cash sales. However bad be business generally, the turnover on these should yield enough profit to pay standing charges, or the bulk of them. To take a simple example: if a contractor could count on selling every lamp bought in his particular town, he could laugh at hard times—simply because lamps are a necessity. It is for every contractor to get as near that ideal as possible, and to supplement the lamp necessity by other electrical necessities by educating an ever-widening circle of the public to consider an ever-widening range of electrical conveniences as essentials to twentieth century existence.

He can only do this if he be loyally supported by the rest of the electrical industry. He has been put in the forefront of the preceding argument because he is obviously the front line of the offensive against the public; and because the attack upon their ignorance, conservatism, and deep-rooted prejudices can be best made by the manufacturers and supply authorities backing up the man who is closest in touch with the "enemy." At present he is sorely handicapped.

He has no effective headquarters' staff. That is largely his own fault, inasmuch as he does not adequately support the E.C.A.—the only organisation that can secure him the advantages he needs.

He fritters away much of his energy in suicidal price-cutting and jealous competition with other con-

tractors. A degree of local co-operation is the obvious remedy.

He has to face the unfair competition of supply companies, who run elaborate and expensive showrooms. If they did that to assist the small contractor, who cannot afford to do it for himself, it would be a step in the right direction. But they don't. They do their best to starve him out by selling direct to the consumer. Worse than that, they actually, in many cases, compete with him in installation work. Their sole object being to supply electricity, they are quite prepared to, and usually do, carry on their contracting department at a loss, happy in the assurance that it will be met from the pockets of the ratepayers, including the contractors themselves. Unfair and foolish are words too mild for such a policy. It is dishonest, immoral. What an outcry there would be from the drapers, say, if a provincial Corporation started a haberdashery store, selling ribbons and laces at cost price!

Finally, contractors are harassed by the desultory sniping of the manufacturers in their rear. Contractors naturally would prefer manufacturers to sell to the public only through them. That is, for many reasons, an impossible ideal. But there is plenty of room for a closer approximation to it; and there is crying need for a definite ruling as to who may buy and what may be bought direct from the works.

Manufacturers are too fond of flirting with the non-trade discount-snatcher. To accommodate the jerry wireman, the plumber, and the toyshop dealer, who only order against sales, they are too apt to stretch their terms to the same limit as they accord to the genuine contractor who advertises, stocks, and shows their goods. They are too prone to tout for direct orders, which left alone, would reach them eventually through a contractor.

The members of the E.L.M.A. are perhaps the gravest offenders in this respect. Their travellers in every large town canvass the chief institutions, factories and shops. They book orders for grosses of lamps, at "trade user's" discounts, without reference to the local contractors, to whom the order would otherwise have gone, with the benefit of the difference in terms. Incidentally, they teach the potentially best customers of the contractor to ignore him and go direct to suppliers for all their other electrical requirements.

If a lamp traveller is tackled on the point, he urges that he does it in self-defence. If he, A, doesn't do it, B or C will. The inference is that if A, B, and C abstain from touting, the consumer will, in some miraculous fashion, avoid buying any lamps at all: whereas the fact, of course, is that, when he wanted them, he would order them from a local contractor. In short, the apparent policy of the E.L.M.A. is to tie up the contractor securely with arbitrary restrictions, and then fight behind his back for his legitimate profits.

If the individual members of the E.L.M.A. are so anxious to secure orders for themselves, and cannot trust the contractor to get them for them, let them tout by all means. But in all fairness, any orders they obtain should pass automatically through the hands of those local contractors who have signed the E.L.M.A. agreement. As it is, it is no secret that the Lamp Ring is, by reason of its methods, more unpopular with contractors than any other of the price-controlling combines.

But they are not the only ones who fetter the contractor with an agreement and then ignore his interests. Anybody, for instance, can buy a motor at trade price; and it is a very elastic line indeed which defines the conditions under which a shop or factory can buy cables or switchgear on the same terms as contractors.

Contractors are not all so unreasonable as to expect, to take an extreme case, preferential terms over a railway company. But they can, and do, object to the pork butcher next door getting the materials for his electrical sausage machine at trade prices.

It is not within the scope of this article to suggest a remedy for this state of affairs. Something is already being done to come to a better understanding with manufacturers. More would be done were the E.C.A. stronger; and it is largely the fault of the contractors themselves that it is not.

The essential point all parties have to bear in mind, if "business" is not to remain "bad," is co-operation. The contractor has to look to the manufacturers, with their larger organisation and capital resources, for the sinews of war—the intensive propaganda work: circulars, pamphlets, and press advertisement. In return they must be prepared to allow them freedom of action, within defined limits, to exploit fields and open up prospects, larger and wider than the smaller resources of the average contractor can adequately handle. The selling of a gross of lamps, by the way, does not fall within that definition.

Manufacturers, on the other hand, should realise that the contractor, with his local connection and intimate knowledge of the public's requirements, is better able than they to keep in touch with possible developments. Let them assist him loyally, nor seek to deprive him of the small profits that keep him in action. It is surely obvious that it is better he should have what discounts are going, and so keep profits in the industry, than that they should be given to outsiders, and so lost.

The manufacturers are the big guns, the heavy artillery; the factors and the supply companies are the commissariat; and the contractor—not the jerry wireman or the side-line dabbler—should be looked upon as the infantry: all engaged in the attack on the lethargy of the public. The artillery are not expected to rush forward, to try and seize strongholds of trade for themselves; their rôle is to put up a barrage of propaganda and put over the munitions. The commissariat are all wrong if they feed the "enemy" with trade discounts, or starve their "front line" by subsidised competition. The infantry—often all too lightly equipped—bear the burden of the attack. If they—if the contractors—cannot count upon the co-operation and the loyal support of the other members of the industry, the attack will fail, and will continue to fail; and "Business is bad!" will become a truth instead of being, as now, a possibility to be avoided.

REMOTELY-CONTROLLED SUB-STATIONS.

The Maidstone Example.

The success that has attended the development of semi-automatic and completely-automatic sub-stations in the U.S.A. in recent years has attracted considerable attention and, incidentally, remote control has made it possible to utilise a considerable number of small water powers that otherwise could not have been developed on account of the cost of operating labour.

Automatic equipment is chosen in consideration of the economy that it facilitates by reason of the elimination to an appreciable extent of the light-load losses and of the reduction in labour cost that it affords. Several of the American automatic stations are of considerable size, and some of them seem to be quite the nearest approach to a reasoning mechanism that has as yet been devised.

In this country, however, progress in this direction does not appear to have been made to any extent. Nevertheless, a small sub-station that is partly remotely controlled has been in operation quite successfully at Maidstone, in Kent, for the past 15 months. The sub-station, an interior view of which is reproduced in fig. 1 and for which all the equipment was furnished by the General Electric Co., Ltd., is located about three-quarters of a mile from the generating station; electricity is received by means of a 0.15 sq. in. 3-core, 6,600-volt underground cable, and about 1,000 h.p. is distributed at high pressure, being transformed down on the consumers' premises; the 3-phase e.h.p. switch-

board is not shown in the illustration, but it consists of a machine panel, an instrument-transformer panel, three outgoing and two incoming feeder panels, and is of the cubicle type.

The d.c. load is carried by the rotary converter and switchboard shown in fig. 1; the former is capable of an output of 500 kW at 500 volts and 1,000 r.p.m., and the latter is composed of one machine panel and four feeder panels, both being of standard type.

The feature of the sub-station is the fact that it does not require anyone to be in constant attendance. The machine is started up and put on load by hand in the ordinary way in the morning, after which the attendant is free to leave and attend to other duties. The load on the machine is indicated at the generating station by an ammeter, and when the time arrives to shut down the converter, the operation is carried out from the generating station by means of a pilot cable that is arranged to trip the d.c. and a.c. machine circuit-breakers at the sub-station—a simple scheme that has functioned well.

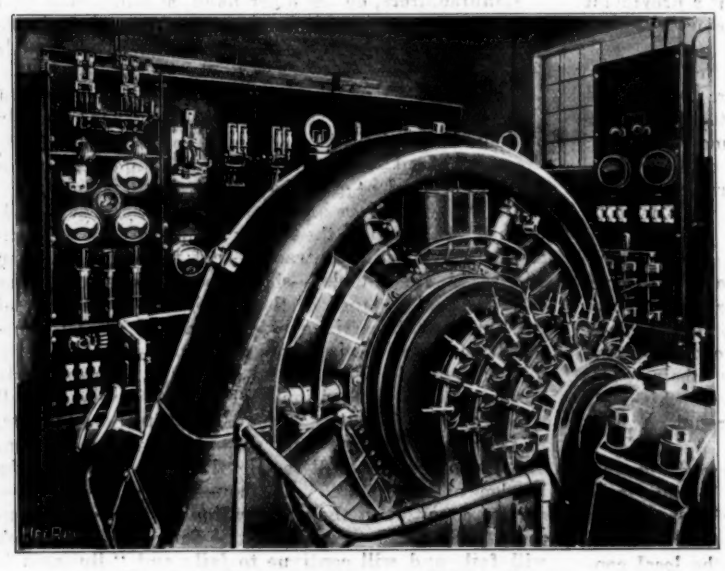

Fig. 1.—A Remotely-controlled Rotary Converter.

In conclusion, we have to thank Mr. E. E. Hoadley, M.I.E.E., engineer and manager of the Maidstone electricity undertaking, for permission to inspect the installation and to publish details thereof.

DOMESTIC LABOUR SAVERS.

By MARGARET PARTRIDGE, B.Sc.

A great deal has been said and written about the need of educating the public up to the advantages and uses of electricity as a labour saver, and not one word is exaggerated.

It is difficult for the manufacturing or technical engineer to realise the extent of the ignorance of ordinary householders about electricity; 45 per cent. are genuinely afraid of it, 45 per cent. assume a swaggering familiarity and "do their own repairs," *i.e.*, put in heavy copper wire ("electric wire" they call it) when a fuse goes, and the odd 10 per cent. make the best use of their electricity because they take the trouble to master a few simple facts. That is the engineers' point of view.

The housekeepers' point of view is not so often published. It is, as a rule, rather nebulous and indistinct and is mixed up with £ s. d. It might be expressed thus:—"If I were to start trying labour savers, I should always be in the hands of the electrician and I should be ruined before I had tried half the things I have been told are good."

There is truth in the statement too. The housekeeper has two genuine grievances: (1) There are on the market far too many expensive accessories, each capable of doing one thing, many of them only useful on infrequent occasions and disappointing to the over-driven housewife who is expecting material help from them. (2) Electricians and salesmen are not always to be relied on to give instructive and illuminating information to the purchaser who habitually thinks in terms of pounds, pints, and pence. If we can find the cause and remedy for these two ills we shall have gone far towards making every household "electrically driven."

Household accessories may be divided into two classes—heat-producing and power-producing. The former class include irons, toasters, haircurlers, grillers, various kinds of hot-plates, immersion heaters, electric saucepans and kettles, ovens and frying-pans, and innumerable types and sizes of radiators; a regular army of useful trifles, each needing a little knowledge and experience to get the best out of it. This is where most of the trouble lies; the purchaser doesn't know how much heat she may expect from her purchase, and in most cases she is unable to regulate it to suit her requirements unless she buys a cumbersome stationary cooker.

A lady of my acquaintance bought a large hot-plate, hoping to boil coffee and milk on it—and then complained that electricity was no good. Why? The hot-plate was only meant to keep dishes warm.

In the first place, the makers should be compelled to mark articles so as to indicate clearly the current they are meant to take, and in the second place, all travellers who go from town to town saying: "This article consumes 1½d. an hour" irrespective of the supply rate of the town they are in, ought to be electrocuted.

One day an intelligent designer will revolutionise the whole situation by putting on the market false-bottomed utensils and a standard range of heating units which can be slipped in at will, and it will be possible for a cook to "boil for ten minutes and then simmer for an hour," or to tell at a glance if her unit is suitable to fry an omelet, or only to warm a plate, and the purchaser will be saved the necessity of buying separate and expensive articles for every culinary operation.

The situation with regard to the power-producers also shows room for improvement. The accessories now in use include fans, vacuum cleaners, sewing-machine motors, buffing machines of all sorts, mincing machines, pudding mixers, and washing machines of all sorts, all expensive, and most of them rather alarmingly complicated to the ordinary housekeeper.

With the exception of the vacuum cleaner, none of these machines is in daily use in the average household, yet each would find its place there if it were simpler, cheaper, and if the housekeeper could be persuaded that it would really be of use to her. An improvement which will come some day will be a universal motor with attachments for nearly all the small-power machines used in the household, so that it will no longer be necessary to buy a motor with each machine. Meanwhile, however, much can be done in the way of assisting the housekeeper in the matter of choosing and using the articles now at her disposal.

Take the case of the vacuum cleaner: At the last Ideal Home Exhibition there were thirteen firms exhibiting electric vacuum cleaners, and each was "the only one of use as a cleaner." The other day a salesman said to me: "Within the last month I have been

instrumental in sending four vacuum cleaners of other makes to auction sales. I proved that they were useless when compared with this." Splendid! No doubt that man is worth a fortune to his firm, but salesmanship which owes its success to proving other articles of no use does more harm to the electrical industry than good to the firm. The recent correspondence in the Electrical Review gave indications of the state of affairs where cleaners are concerned, and there is no doubt that the poor harassed housewife wanting to buy a vacuum cleaner will be told that one make is too heavy to lift, another will wear out the carpet, a third will not pick up the dust, and so on. In the end it will not be surprising if she decides that it is too great a risk to buy a cleaner at all.

Perhaps there is not so much competition over the other power-producers, but even here harm is being done by over-enthusiasm on the part of the salesman. If there are genuinely bad machines, it should not be left to the opposition salesman to point them out.

The electrical industry would be materially assisted if standard tests were instituted and accessories were awarded prizes or certificates for fulfilling their various functions satisfactorily. There is a Bureau for Housewives which does a little towards helping with advice; machines have to pass a stiff test of "domestic efficiency" before being put on its list of useful accessories, but the mechanical and electrical aspects of the case are ignored. Unfortunately, this Bureau is not very widely known, and in any case certificates of merit should not be granted without regard to engineering efficiency and reliability as well as to domestic utility. If a widely-recognised authority were to inaugurate an examination which took account of every aspect of the case, and an article which was awarded a first-class certificate by such a body were known to have passed tests which would satisfy the housewife as well as the engineer, then no doubt there would be less reluctance on the part of the householder to embark on a course of electric labour saving.

THE BRITISH ASSOCIATION.—I.

After the long interval of sixty-nine years, the British Association for the Advancement of Science has again met at Hull for its annual conference. The varied features of the city, which as Kingstown-upon-Hull received a charter from Edward I in 1299, make it of interest to nearly all the Sections comprising the Association, but perhaps most of all to geologists. As a highly-developed industrial and commercial city it can claim the attention of engineers. It is unique in at least one respect, *i.e.*, it is the only town in the United Kingdom with its own telephone system. This has been held up as an example of efficient management and as a testimony to the success of municipal ownership. A net profit of £4,000 was realised during the past year, and altogether £74,000 has been paid in royalties to the State, including £10,000 in 1921-22. The system has over 12,000 subscribers. The city has another profitable undertaking in its tramways, which provide adequate services for the city's 300,000 inhabitants as well as for those in outlying districts. An attempt to brighten the city by means of artistically-decorated cars was essayed last year. The system has its own generating station, with a plant capacity of about 3,000 kW. The electricity undertaking which supplies power over a wide and important area has a plant capacity of over 15,000 kW; further plant to the extent of 10,000 kW is being added; this will rank the undertaking among the largest in the country. As in many other cases, the coal stoppage had an adverse effect upon the undertaking, but the supply was maintained by the use of oil fuel, which, although a costly method, enabled the dependent industries to be carried on.

The headquarters of the Association are at the Guildhall, and the various Sections are housed as follows:—A.—Mathematics and Physics, Central Hall; B.—Chemistry, Waltham Street Wesleyan Hall; C.—Geology, and H.—Anthropology, Royal Institution; D.—Zoology, E.—Geography, K.—Botany, and M.—Agriculture, Municipal Art School; F.—Economics, Queen's Hall; G.—Engineering, City Hall; I.—Physiology, Church Institute, Albion Street; J.—Psychology, Albion Hall; and L.—Education, Lecture Hall, Jarratt Street.

This year's president is Sir C. S. Sherrington, G.B.E., &c., President of the Royal Society and Waynfleet Professor of Physiology, Oxford. Among the many services rendered to the public by Sir Charles may be mentioned his membership of the Home Office Committee on the Lighting of Factories and Workshops, and his chairmanship of the Industrial Fatigue Research Board. He has held numerous important posts in the sphere of physiological education, and his services have been recognised by many British and foreign learned societies.

Prof. T. Hudson Beare, president of Section G—Engineering—is Regius Professor of Engineering at Edinburgh University, and is a recognised authority on the Australian railway problems which form the subject of his address.

The proceedings proper opened on Wednesday evening with the delivery of the presidential address. The subject was somewhat beyond our scope—"Some Aspects of Animal Mechanism"—although many striking analogies between living bodies and machinery were brought out.

On Thursday morning each Section commenced upon a very full programme. In Section A—Mathematics and Physics—the first item was a discussion on the "Origin of Magnetism." Prof. P. Langevin, of Paris, opened with a short paper, and the speakers included Prof. P. Weiss (Strasburg), Principal Sir J. A. Ewing, F.R.S., Dr. A. E. Oxley, and Mr. L. F. Bates. In the afternoon Sir William Bragg, F.R.S., lectured on "The Significance of Crystal Analysis." Principal J. C. Irvine, C.B.E., opened the proceedings of Section B—Chemistry—with his two-part presidential address, "The Organisation of Research" and "Some Research Problems in the Carbohydrates." The first part of the address sounded a warning against the employment of investigators who had not received a sound training. This did not necessarily mean that intellectual freedom would be lost; a proper training gave a direction and prevented the waste of time in unprofitable by-paths. Sympathetic supervision was necessary; it was easy to use the technical skill of a graduate to carry out the more laborious and mechanical parts of one's own researches, but the outcome of such a policy needed no elaboration. The speaker dealt with many other points of value, and in conclusion advocated for each institution a board or standing committee entrusted with the supervision of research and the supply of the requisite materials, funds, &c.

In Section F—Economics—Mr. J. L. Cohen read a paper on "The Future of Unemployment Insurance." He considered the fundamental principles of the British scheme of insurance as sound, but inadequately applied. Among the points raised were:—"Should industries bear the cost of maintaining their own unemployed?" and "Can insurance be so organised as to reduce the amount of unemployment?"

The whole of the attention of Section G—Engineering—was absorbed by the study of the strength of railway bridges; Messrs. A. G. Cookson, J. S. Nicholas, Conrad Gribble, and J. S. Wilson, and Prof. B. P. Haigh made contributions to the symposium. The morning was occupied in Section J—Psychology—by papers and discussions on various phases of the application of the science to industry. Dr. C. S. Myers, the

president of the Section, read a useful paper defining the psychologist's attitude to the efficiency engineer. This is reproduced in abstract below. "Practical Applications of Vocational Tests" was the subject of a paper by Mr. J. Seebohm Rowntree, Jr. In Section L—Education—the programme commenced with the delivery of his presidential address by Sir Richard Gregory. This address, which contained much food for thought for those responsible for the teaching of science in elementary and secondary schools, is given in abstract form below.

The Efficiency Engineer and the Industrial Psychologist.

Presidential Address by Charles S. Myers, C.B.E., M.D., F.R.S. (*Abstract.*)

Section J.—Psychology.

This paper is in the nature of a sequel to that contributed by Dr. and Mrs. F. B. Gilbreth to the Barcelona Meeting last year of the International Conference of Psychotechnics applied to Vocational Guidance. The author considers that Dr. Gilbreth, in his methods and nature an engineer, is the true successor of F. W. Taylor. The Gilbreths' paper addressed the industrial psychologist from the efficiency engineer's standpoint; the present paper reverses their positions, and points out to the efficiency engineer the limitations of his work unless it be carried out with due regard to its psychological complications. The psychology of the worker differs according to social and other conditions, but in no circumstance is it justifiable to tell a worker, as Taylor did, that "a high-priced man has to do exactly as he's told from morning to night." That is precisely what a worker fears will result from the application of motion study. If experts, appointed solely by the employers, are to go round a factory observing, codifying, and standardising the most efficient methods of operation, the worker suspects that he will be robbed of his craft skill and will be treated as a mere piece of machinery. The Gilbreths insisted that the psychologists should understand that the "quest of the one best way" was the crux of the present industrial problem. To this, the adequately trained psychologist retorts: "There is no one best way"; the psychological and physiological differences between individual workers are such that it is impossible to train and expect all to adapt themselves to perform operations in precisely the same way. Such an aim is harmful, discourages initiative, and is impossible of achievement. Thus the industrial psychologist is diametrically opposed to Taylor's ideal of "scientific management" that under present usual conditions "the managers . . . . assume the burden of gathering together all the traditional knowledge which in the past has been possessed by the workmen." Whatever information of this kind is obtainable can only be satisfactorily collected with the full understanding, consent, and co-operation of the workers. Secret timing is a flagrant violation of the principles of industrial psychology. The experience of the National Institute of Industrial Psychology has been that the workers' confidence and collaboration *can* be obtained; this would be impossible in an atmosphere of suspicion and unfriendliness.

The efficiency engineer commonly proceeds by analysing a given operation into a number of different parts, observing and tabulating the movements of those operatives who perform each of those parts in the quickest time, finally collecting into one series the quickest and best movements as the "one best way" which is then stereotyped and forced on every worker. The individual has characteristics which are not to be found in his individual parts and his best mode of movement is not to be derived from a combination of more elementary movements selected from different operatives on a basis of speed. Nor, indeed, is it justifiable to conclude without adequate evidence that the speediest or shortest movements are necessarily the least fatiguing. The "minute divisions of motion study" enumerated by Gilbreth have no psychological or physiological interest or basis whatever. It will be a bad day for industry if the worker comes to believe that discovery and construction are considered by the management to be outside his scope, and that his function is that of an automaton.

According to Taylor, "No worse mistake can be made than that of allowing an establishment to be looked upon as a training school, to be used mainly for the education of many of its employés." The industrial psychologist insists that an establishment depends for its very life and efficiency on the extent to which it is utilised as a training school and as a means of properly educating those who work there. Can anyone suppose that the best mode of getting the best work out of an employé is by bidding him, in Taylor's words, to "bear in mind that each shop exists, first, last, and all the time, for the purpose of paying dividends to its owners?" Instead of trying to appreciate the various emotional influences and incentives which affect the worker's efficiency, the efficiency engineer is led by his mechanistic interests rather to determine and set the task which may be expected of an efficient worker, and to devise some elaborate scheme of payment which, in his fond imagination that wages are the best incentive to production, will induce the worker to give his best. From the same standpoint the Engineering Correspondent of the *Trade and Engineering Supplement* (*sic*) of *The Times* insisted that the sole function of industrial psychologists was to give "a plain and uncoloured statement of the facts they are asked to measure and not to concern themselves with either the ethical or the economic aspects." This seems to imply that the psychologist is debarred from inquiry into the existence and origin of factory worries and discontent, and that he can always satisfactorily "measure the facts" without investigating other, widely remote, complicating conditions of a psychological character. In actual practice his scope must often be extended in this way, and if the confidence of the employer and the employed can be obtained, he should be at liberty to so extend it. From his mechanistic standpoint the efficiency engineer expects man to behave like a machine, turning out a constant hourly output. The industrial psychologist recognises and investigates the various factors that inevitably enter into, and influence, the form of the work curve. The laboratory investigations carried out by the "pure" experimenter, with ergographic and mental work tests, are not directly applicable to actual conditions. With regard to vocational tests, these must be considered as the servant, not the master of the industrial psychologist; they promise to be of the greatest value but always require interpretation in the light both of the individual tested and of the industrial, psychological, and physiological knowledge and experience of the observer. The numerical data afforded by such tests can only assist, they can never solely determine an appreciation of an individual's special aptitudes. Not only must what a person does at a test under given conditions be considered, but also how he carries out that test, and also his entire personality.

The author does not deny that there are many improvements in the factory which are independent of physiological and psychological knowledge and can best be carried out by the efficiency engineer. But there are many other, even more important, improvements which devolve on the industrial psychologist, either alone or in co-operation with the efficiency engineer. There is a wide borderland in which the best results can be obtained by intimate co-operation, each recognising his limitations and availing himself of the expert qualifications, the natural interests, and the different outlook of the other.

Education and School Science.

Presidential address by Sir Richard Gregory, F.R.A.S., F.Inst.P. (*Abstract.*)

Section L.—Educational Science.

The Educational Science Section of the British Association was established twenty-one years ago with the object of introducing scientific conceptions into every sphere of educational activity. The essential attribute of all scientific investigation is the spirit of discovery, and the standards by which the results are judged are not necessarily those of practical application. Teachers too often forget this when contributions to knowledge of mental processes are brought before them. Education may be defined as the deliberate adjustment of a growing human being to its environment; and the scope and character of the subjects of instruction should be determined by this biological principle. The resources available for teachers provide better opportunities at the present time than ever before. While art and literature remain practically unchanged, science has transformed the whole landscape entrusted to it and the realm of its productivity is continually extending. School instruction in science is not intended to prepare students for vocations but to equip them for life as it is or may be, to give them an intelligent view of things in general. The science taught in primary and secondary schools should be science for all, not for embryonic engineers, chemists, or even biologists. Most of the science courses in these schools are suitable enough as preliminary studies of a professional type, but they are too specialised for general benefit. The needs of the many are sacrificed to the interests of the few. Exceptional students may profit by the study, but to the others it often appears trivial or sordidly practical, and is usually spiritless. Advocates of both literary and scientific studies are agreed that science should be integrally and adequately represented in the education of all pupils up to the age of sixteen, and the Headmasters' Conference has subscribed to the view that this should be generalised and that after the age of sixteen students desirous of taking up a special subject should be able to do so. A study of the present conditions suggests that general scientific teaching is almost non-existent. Pupils often leave school when their only introduction to science has been the study of mechanics and heat, and without the slightest knowledge of such a common instrument as an electric bell. One or two examining bodies have introduced general science syllabuses covering the rudiments of physics and chemistry as well as of plant and animal life, but as in most cases these subjects must be studied experimentally, few schools find it worth while to cover such schemes of work. The educational value of the usual science course in secondary schools is small as

it is generally confined to quantitative work in physics and chemistry; much of the work described as physics really belongs to mensuration. By the prevailing obsession with regard to quantitative work the pupil is made the slave of the machine. The ideas of Herbert Spencer, John Dury, Locke and Rousseau, which may be summarised as teaching as little as possible to pupils but inducing them to discover as much as possible, were admirably utilised by Prof. H. E. Armstrong in drawing up detailed schemes of work—on what has since been termed the "heuristic" system. A necessary condition of the research method of teaching science is that the pupils themselves must consider the problems set before them as worth solving—not merely laboratory exercises. The difference between subject and method must be considered. The mission of school science is not only to provide training in scientific method, valuable as this is, but also to provide pupils with a knowledge of the nature of everyday phenomena and applications of science, and of the meaning of scientific words in common use. One reason for the rarity of general science instruction in secondary schools is due to a great extent to the fact that the teachers themselves are specialists with little knowledge outside their particular territory. Where, however, the general science teachers exist they are compelled to conform to syllabuses which restrict their scope. A third reason is the necessity for apparatus and equipment; it would be impracticable and educationally ineffective to provide the means by which all students could observe for themselves a wide range of unrelated facts and phenomena in both biological and physical fields. It is very difficult, however, to devise a laboratory course which shall be both coherent and educative; in other words, extensive in scope and intensive in method. The main thing is to avoid the limitation of science teaching to what can be done practically; for no general survey is possible under such conditions. It has to be remembered that science, like art, is long while school life is short, and that though practical familiarity with scientific things must be limited, much pleasure and profit can be derived from becoming acquainted with what others have seen or thought.

The address is a plea for the expansion of scientific instruction in this humanising spirit, for widening the gateway into the land of promise where the destinies of the human race are shaped.

POWER STATION ENGINEERS' SALARIES.

The Employers' Side of the National Joint Board of Employers and Staff Members (Electricity Supply Industry) has formulated a series of proposals which the Electrical Power Engineers' Association describes in its August journal as "in effect, a complete revision of the existing schedule." In the *Electrical Power Engineer* the proposals appear *in extenso;* we give below some of the principal changes, with, in some cases, amendments to the schedule suggested by the E.P.E.A.

The chief alterations are those made in the "plant capacity" headings of the salaries schedule which determine rates. In the existing schedule the following arrangement of classes is adopted: A, 1,000 to 2,000 kW; B, 2,001 to 4,000 kW; C, 4,001 to 6,000 kW; D, 6,001 to 8,000 kW; E, 8,001 to 10,000 kW; F, 10,001 to 30,000 kW; G, 30,001 to 50,000 kW; H, 50,001 to 100,000 kW; J, 100,001 kW and over. The employers' proposals leave classes A, B, G, H, and J untouched, but the remainder are altered as follows:—C, 4,001 to 7,000 kW; D, 7,001 to 11,000 kW; E, 11,001 to 18,000 kW; and F, 18,001 to 30,000 kW. The E.P.E.A. has presented a proposal varying the schedule from Class F onwards, and adding two more columns relating to stations of from 100,001 to 150,000 kW, and to those with a capacity of more than the latter figure. Certain spaces left blank in the schedule, relating to the salaries in Grades 1 and 2, have been filled in. The E.P.E.A. also proposes the addition of grading for undertakings of below 1,000-kW capacity, and the alteration of the extra 5 per cent. in the case of London undertakings to 10 per cent. Owing to the many anomalies which have arisen under the present schedule, both with regard to inside and outside staff, the Association has submitted a complete revision of Section 10, which deals with basic salaries. An endeavour has been made to cater for those cases of all grades where duties are performed which are additional to those normally undertaken by an employé in a particular grade.

The employers propose to amend Section 1 of the schedule by substituting for "generating plant—100 per cent. of the rated "output in kW" two clauses: (*a*) The "normal continuous rated output" and (*b*) the maximum demand, including electricity used for auxiliary purposes, during any continuous period of one hour, under normal conditions, in the financial year immediately preceding the current year after adding to such demand 25 per cent. The smaller figure is to be taken in the classification of the station. The additions to be made in respect of converting and transforming plant used for bulk supplies remain the same except that "kW" has been substituted in the expression "rotary converting plant—40 per cent. of the rated output in kVA." A proviso has been added that "the capacity of a station receiving bulk supplies shall not be deemed to be increased as mentioned . . . . . except in relation to employés who are required to perform increased duties or to assume greater responsibilities by reason of such bulk supplies." It is also provided that where an area is divided into districts the station capacity shall be apportioned *pro rata* to their responsibilities amongst the employés whose duties are not performed in the station; Class A is exempted from this. The E.P.E.A. has submitted revisions of Sections 7 and 8. The bulk supply clause in Section 7 is transferred to Section 8. The latter section, which prescribes percentage reductions of salaries to be made in special cases, *i.e.*, where steam is supplied wholly from outside, in water-power stations, in waste-heat stations supplied from another source, &c., has been amended so that the reductions will apply to the generating capacity and *not* to salaries. Section 2, which deals with temporarily increased responsibilities, has been reworded by the E.P.E.A. to give clearer definition. The employers propose to alter the holiday clause by making the maximum period, apart from Bank Holidays, fourteen consecutive days.

The E.P.E.A. proposes amendments to Section 1, which, in the case of shift duties, will ensure the consideration of overtime caused by the resignation of an official as well as by sickness, &c. The "Day Duties" clause is altered to cover mains assistants and other members of the outside staff more definitely. In connection with this clause the employers put forward an addition that "an employé engaged in day duties in charge of workmen shall work such hours as are necessary for him to effectively supervise such workmen."

The employers' proposals contain nothing defining grades, whereas in the original schedule Grades 1, 3 and 8 are specifically set out as basic grades. As the preamble to the proposals definitely states that they are to supersede the 1920 schedule, it would appear that grading is totally excluded from their scope. With regard to the "illness" clause the new proposals leave the matter of payment to be mutually agreed between employer and employé, instead of fixing a definite scale, as in the 1920 schedule.

There are many other smaller revisions and amplifications in both lists of proposals. We understand that a meeting of the N.J.B. is being held this week to consider the amendments put forward by both sides. The matter is referred to in our leading columns to-day.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Freezone" Refrigerator.

A useful form of refrigerator-cupboard is made by British Engineering Units, Ltd., of Coventry. The arrangement is shown in the accompanying illustration (fig. 1). In the

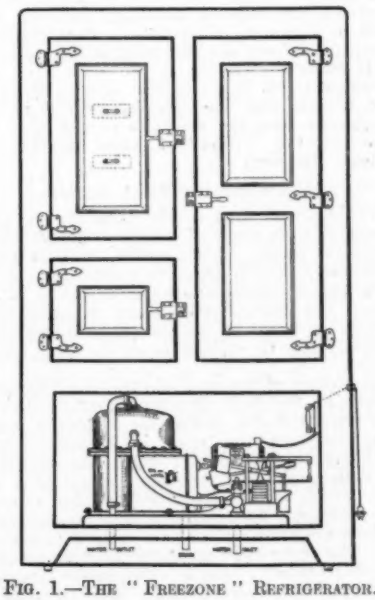

Fig. 1.—The "Freezone" Refrigerator.

upper left-hand compartment is a brine tank containing coiled copper tubing. Mounted on a substantial cast-iron base in the lower compartment is a small electric motor, compressor, condenser, water valve, and an automatic motor switch,

which is actuated by a thermostat situated above the small food compartment shown on the left of the illustration. When the temperature of the food compartments has been reduced to a predetermined level the motor is stopped and the brine circulation ceases. Conversely, when the temperature rises above the limit the motor is started up. The large food compartment on the right-hand side of the "Freezone" is provided with five shelves. The overall dimensions of the equipment are: height, 68 in.; width, 39 in.; and depth 25 in.

The "Ceag" Pillarless Lamp.

The "Ceag" pillarless lamp has been introduced with a view to increasing the amount and distribution of light, and has been approved by the Home Office for use underground, after exhaustive tests in mines over a period of two years.

The lamp consists of a standard miners' lamp fitted with a special reflector carried by a bridle, capable of swivelling in a larger bridle from two points at the side of the lamp top. The large bridle is secured by heavy screwed pins entering strengthening lugs riveted to the lamp top. The

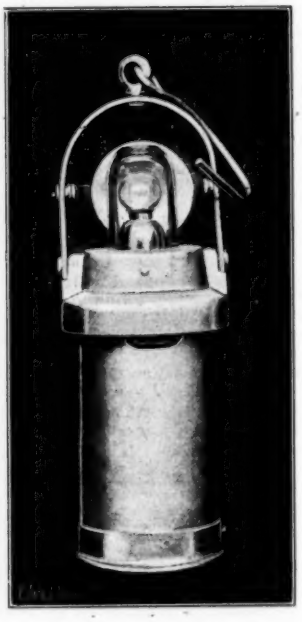

Fig. 2.—The "Ceag" Pillarless lamp.

remaining portion of the lamp is built up of standard parts, interchangeable with the existing standard "Ceag" miners' lamps.

The advantages claimed for the pillarless lamp are as follows:—With the reflector down an increase of light of 70 per cent. is obtained. There are no dark shadows caused by the lamp pillars, and a clear beam of light over an arc of 160 deg. is thrown forward.

The illustration (fig. 2) shows the lamp in front elevation; it will be noticed that the reflector can, if necessary, be placed completely over the wellglass of the amp.

It is made by the "Ceag" Miners' Supply Co., Ltd., Queen's Road, Barnsley.

A New Electric Rivet Heater.

The advantages of electric rivet heating, in addition to those associated with electric heating in general (*i.e.*, cleanness, absence of smoke, fumes, sparks, &c.) are many. The ordinary portable hearth leads to overheating, is comparatively slow, and a certain amount of oxidation of the metal takes place. The electric rivet heater is being increasingly used in portable types to replace portable hearths, and in semi-portable types to replace large oil, gas, coal or coke fired furnaces.

A special feature of the new electric rivet heater (fig. 3), manufactured by the M.P. Electric Welding Machine Co., 28, Hatton Garden, E.C.1, is that the current is automatically cut off as soon as the rivet is heated. It prevents the rivet being overheated and burnt should the operator forget to switch off. The machine consists of a step-down transformer which reduces the supply voltage to about three volts and increases the current. The lower water-cooled electrode jaws are movable, and are cupped to take the head of a rivet The upper jaws are fixed, but can be adjusted to suit rivets up to 6 in. in length. The heater is usually made to heat three rivets independently, three sets of electrode jaws being provided. To obtain the right heat for various sizes of rivets a selector switch for regulating the current is fixed to the machine. All parts carrying the primary current are fully protected and the voltage of the secondary circuit is too low to be felt at all. The machine is practically fool-proof and there is no danger of receiving a shock. It can be operated by any inexperienced person and is ready for use by simply turning on a switch. Hot rivets can be obtain from 10 to 15 seconds, and one or more rivets can be heated at a time, as required. The operator depresses the foot lever and inserts the cold rivet in the upper electrode jaw. As soon as the lever is released the jaw rises and the rivet is clamped tight between the two terminals. At the same time the current commences to flow. In a few seconds,

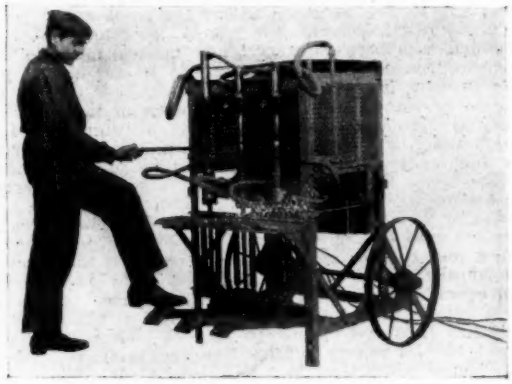

Fig. 3.—A New Electric Rivet Heater.

according to the size of the rivet, the passage of the heavy current will raise the shank to a white heat the head, by reason of its larger size, being rather cooler. An automatic switch cuts off the current when the rivet is sufficiently hot, if the workman forgets to do this.

The heater is made in three sizes taking 8 kVA, 15 kVA, and 30 kVA, respectively. The transformer is designed for single-, two-, or three-phase circuits.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Estimates for Wiring Installations.

I have read with interest the article on estimating for internal wiring circuits; the author touches on some interesting points, but I am of the opinion that errors are not made to a great extent by wrongly estimating quantities.

Having had many years' experience in lighting contract estimating, I have surveyed this problem from all possible angles. It requires little skill to choose, say, two or three representative circuits, measure up these and use them as a basis for the whole of the job. Such procedure I find only gives an error of two per cent., which does not show a two per cent. error on the estimate, because it only affects three items, namely, cable and its protection and labour.

Bills of quantities are difficult matters for the architect, and some consulting engineers who cannot justly appreciate the many little difficulties the contractor is likely to come across.

I think there are three basic reasons for the discrepancy in prices of tenders to-day; they are:—

Faulty specifications.

Failure of proper supervision by the purchaser.

Lack of standards for materials.

Dealing with faulty specifications, here the architect is probably the chief offender; often he obtained his electric light specification, I should say, when he obtained his articles, and has used it ever since.

Specifying: "Wires to be rubber insulated and enclosed in metal casings" is ambiguous, while "Fuses to be mounted on slate bases" shows how ancient the specification is; yet the contractor continually gets this sort of thing.

The former part can be met with cheap continental cables in close-joint conduit, and there are contractors who would install it, while a contractor of repute would possibly install non-association cable made by a member of the C.M.A. in screwed welded conduit.

Again, when sizes of cables or minimum voltage drop are not specified, there are contractors who would put in cables far too small. I would not say that they do it willingly, but using the "maximum amperes permissible" column in the I.E.E. tables, they ignore length of run.

The old rule of one thousand amperes to the square inch is applicable to ninety per cent. of lighting contracts, and the I.E.E. tables only to the large cables, and the man dealing with large cables has sufficient training to use such tables intelligently.

Shades are usually specified as: "Each lamp to be com-

plete with shades." What kind of a shade—a white cone opal, or a metal reflector at six times the cost?

A specification should be accompanied by a plan, and should at least contain the following, besides the usual clauses:—

Gear.—Type of switch, fuse and distributing board.

Mains and circuit wiring.—Size of cables, or to be of 1,000 amperes per square inch capacity. Whether non-association or association. How they should be protected: casing, close joint, brazed or screwed welded conduit. Whether run on the surface of the walls and ceilings, or sunk.

Pendants.—To consist of patress, ceiling rose, flex, lampholder, lamp, and the fixing of the shade or fitting. An inclusive sum should be allowed for shades or fittings.

Switches.—To be sunk in, or fixed on the surface of, the wall. If sunk, an inclusive sum should be allowed for switch plates.

Lamps.—Lamps should distinctly be specified as gasfilled or vacuum, ring or non-ring.

As there are no definite standards, it is essential to mention makers' names or insist on samples being submitted with the tender. Tenders otherwise cannot be compared and are therefore of no value.

A purchaser must, until he has gained confidence in his contractor, inspect the installation frequently during erection. Those engineers who have to inspect and report on installations will realise the importance of this; the amount of scamped work is alarming.

The wireman does not work in the same sense as a plumber, who must make a good job; otherwise the water or gas leaks, and the purchaser sees this immediately. The wireman, on the other hand, can scamp his work, it only being necessary to avoid the critical eye and a low insulation test.

The third factor, lack of standards, is a precedent of varying prices; almost everything shows a wide range in standards of quality and therefore of price.

To name a few: Cable 3 to 1, tumbler switches 2 to 1, lampholders 5 to 3, conduit 4 to 1, distribution boards 3 to 1.

This is a problem that cannot easily be overcome; the insisting, on the part of the purchaser or his agent, on the submitting of samples with the tender would give the purchaser greater ability to choose.

There are many contractors who would welcome these reforms; the need to-day is more urgent than before the war, when the trade was free of the "cheap jacks" prevalent to-day because price rules.

Lodestone.

Manchester, *September 2nd*, 1922.

The Lightning Conductors of the County Hall.

Please allow me to correct an error made by Mr. Killingworth Hedges in your issue of the 25th inst. He refers to the Mersey Dock Board's Liver building; this should read Mersey Docks and Harbour Board office. The Liver building situated close by, has two 1¼-in. by ¼-in. copper-tape lightning conductors fitted to each "bird," four in all, 306 ft. above ground, and they descend to earth without a joint. This is a ferro-concrete building, and the dock office is a steel-frame building. I was the contractor for both systems of lightning conductors.

H. G. Riddell.

Liverpool, *August 31st*, 1922.

The Village Power Station.

Owing to my absence on holidays it is only to-day that I have seen the letter from "Arcadia" on this subject in your issue of August 25th. I know nothing of the schemes mentioned by "Arcadia," but as general manager of Edmundsons' Electricity Corporation, Ltd., I am closely connected with over forty small electricity supply undertakings, and I have had to approach the Electricity Commissioners on various subjects, including the permission to establish new undertakings, and I have seen nothing of the "do-nothing and dog-in-the-manger policy of the Commissioners" which "Arcadia" tells us has caused his schemes to be hung up.

My experience has been so entirely different to that of "Arcadia" that I feel compelled to trouble you with this letter; not only have I received the greatest courtesy and attention from the Commissioners and their staff, but on many occasions numerous individuals at the Commission have put themselves to a lot of trouble to be helpful to our branch of the industry. To quote one instance, I was supplied with information as to a likely source from which a supply in bulk might be available, which in fact was obtained on suitable terms, thus reducing capital expenditure at a time when capital was very difficult to obtain.

From the nature of their duties the Electricity Commissioners cannot be expected to satisfy all the conflicting interests with which they come in contact, and some of their decisions I have found it difficult to understand, but I am convinced that the future for the smaller electricity supply undertakings has greatly improved since they have come under a department which understands something of the needs of their branch of the industry.

From my personal experience I feel certain that the Commissioners are anxious to assist the smaller towns and villages to obtain a supply of electricity, provided the scheme is a reasonable one, and that it does not conflict with the larger schemes necessary for the future development of the district. What more can we desire than a fair decision on these lines?

For the past few years the development of new undertakings in the smaller towns and villages has been nearly impossible, partly through the high cost of material and labour, and partly through the effect of the Temporary Increase of Charges Act, which reduced the smaller electricity supply undertakings to such a deplorable financial position that the credit of this branch of the industry was practically destroyed. Capital could not be obtained for new work when the majority of the older companies were prevented from paying dividends equal to the deposit interest offered by the banks.

To-day the fall in prices has removed one of these difficulties, and we have to thank the Electricity Commissioners for the removal of the other difficulty through certain clauses of the Electricity (Supply) Act, 1922, which supersede the impossible conditions of the Temporary Act.

This broader policy, for which, I repeat, we have to thank the Commissioners, should rapidly restore the credit of the smaller undertakings, and attract capital to our industry.

In those new undertakings in which the brighter outlook has induced my company to participate I have met with nothing but encouragement from the Electricity Commissioners.

A. N. Rye.

Westminster, *September 1st*, 1922.

Lamp Discounts.

I, in common with all other electrical contractors and retailers, have received from the secretary of the E.L.M.A. a circular giving the new scale of discounts that it has decided to grant retailers in place of the present grading.

I notice that in every case the retailer is going to lose at least £2 15s. on every £100 worth of lamps he sells, compared to his present terms, and in a good many cases the retailer will lose a great deal more.

The E.L.M.A. informs us that this will take place on the occasion of the next reduction in the price of lamps, so that if lamps are reduced 15 per cent., the retailer, though doing exactly the same business in lamps during the coming year as he did last year, will lose at least £8 per £100, in some cases more.

For example, if his sale of lamps for the year ending March 31st, 1922, was £400 and he sold the same number in the next year, the sale would total £340, and the difference he would receive in profit, according to the E.L.M.A. circular, would be £29 11s. 7d., so that the retailer stands to lose half the reduction in the price of lamps, without any advantages worth mentioning.

In reply to the question: "Would there not be a greater sale for lamps if they were cheaper?" No! my customers would not buy a single lamp more, as they buy them to use and not to put them on a shelf to look at because they are cheaper.

To the best of my recollection, when the Royal Commission was inquiring into the profits made out of lamps, it found that the cost of making a lamp was about 8d. or 9d.; since then, wages have been greatly reduced, raw materials are cheaper, and improvements in machinery have all tended to greatly reduce the cost per lamp.

Not content with the increased profits, the E.L.M.A. is now endeavouring to obtain a part of the small profits that retailers receive on the sale of lamps.

Where was the Electrical Contractors' Association when these terms were decided? I have heard that it agreed to them, but can hardly credit it. I (a small contractor), would have fought strenuously against it, if I had had any say in the matter, and I would agree to be loyal to any movement that would give the retailers back their old terms.

One idea that I offer to contractors in general and that I would adhere to, if decided on, is that all contractors should refuse to buy any sort of accessories (from a wood block to a motor) from or made by any of the firms in the E.L.M.A. ring (there are plenty of good accessories made by British firms outside the lamp ring), and also buy all their lamps from factors, making the lamp ring pay the highest terms to them; that would be one of the ways of showing the E.L.M.A. that it is not the absolute master it thinks it is.

A Small, but Hard Hit Contractor.

August 23rd, 1922.

Making Hay the Electric Way.

With reference to the article you published in your issue dated August 25th on the above subject, based on notes on my work in this direction, supplied to you by the Electrical Development Association, in reply to the letter from Mr. Justus Eck, I would say that in all I cured three large stacks; the first figures in your article refer to the second rick, which was smaller than the first, and consisted of green grass, soaked with rain. The second figures referred to a larger stack which I cured first (with less experience naturally), consisting of green grass. The current consumption was even less for the

third rick, which consisted of green grass, cut late one day and stacked early the next day. On the basis of the maximum figures, even the farmer is well in pocket.

I find that my method has been misunderstood to a certain extent. The problem I have been working at during recent years is the *making* or *curing* of hay, *not drying* grass. A number of experiments have dried grass successfully, but the result is not what the farmer or his stock appreciate as *hay*. Proper hay is the product of certain complex bacteriological and chemical changes, concerning which there seems to be very little information available. By long experience and good judgment a good farmer can obtain these results, by properly working the hay in the fields, carting it at the right moment, and making his stack of the correct size.

By the electrical method, if certain simple rules are followed, an unskilled labourer can obtain as good hay as an experienced farmer—and further, the question of weather is entirely eliminated. It was the question of weather that started me on the problem, but now I find that in addition one can cut the grass when it is ready, be more certain of the quality of the hay, and also reduce the labour required.

R. Borlase Matthews.

Greater Felcourt, East Grinstead.
September 1st, 1922.

Calculating Currents in a Mesh-Connected Three-phase Circuit.

There has recently come to my attention an article by Prof. Alfred Still, appearing on page 78 of your issue of July 21st, 1922, and entitled "Calculating Currents in a Mesh-Connected Three-Phase Circuit." Since there appears to be a fallacy in Mr. Still's reasoning, it may not be amiss that I should call your attention to the matter.

Knowing from experience that a knowledge of the magnitudes and phase relations of the line currents does not determine the currents within the mesh, I have been forced to look for the "hole" in Mr. Still's argument; and this seems to lie in the assumption with which he begins his "proof." There he states that "Since the vectorial addition of the three currents in the mesh must be zero, . . ." Now, I am of the opinion that a second thought will reveal the fallacy of this assumption; for if we imagine the mesh to be composed of three adjustable single-phase loads, it is a simple matter to vary any one of these components without in any way affecting the currents drawn by the others. Therefore, the vectorial sum of these currents may have any value, and would be equal to zero only in special cases. And since this assumption cannot be made, the proof consequently fails.

While the vectorial sum of the currents in the three lines must be equal to zero, and the vectorial sum of the voltages around the mesh must have a similar value, it does not follow that the same holds good of the currents in the mesh.

I am forwarding a copy of this letter to the writer of the article.

Perry A. Borden.

Toronto, *August 19th*, 1922.

Electric Battery Locomotives.

With reference to your review on "Electricity in the Service of Man," page 287 of your issue of August 25th, we respectfully point out that discharges of 150 amperes from a battery of 108 ampere-hours would not be out of the way momentarily for the work which these locomotives have to perform.

Nevertheless, a greater capacity is usually employed. On the Midland Railway locomotive where our battery is installed, there are 108 cells of 300 ampere-hours capacity. This battery has now been in daily use for about nine years; only positive plates have been renewed, and that was after five years.

The "D.P." Battery Co., Ltd.
T. C. Elliott.

Westminster, *September 4th*, 1922.

BUSINESS NOTES.

Bankruptcy Proceedings.—T. Carter, electrical engineer, 2, South Street, Dorchester, and High Street, Swanage.—Last day for proofs for dividend, September 18th. Trustee: Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C.

F. H. Dennis, electrical engineer, 20, High Street, Chelmsford.—First meeting September 15th at 29, Russell Square, W.C. Public examination October 4th at the Shire Hall, Chelmsford.

Company Liquidation.—Stockwell & Ohms, Ltd.—Particulars of claims to be sent by September 29th to Mr. H. Holmes, 2, Fenchurch Avenue, E.C., or Mr. W. Osborne, Balfour House, Finsbury Pavement, E.C., joint liquidators.

Dissolution of Partnership.—M. P. Tundley & Co., electrical engineers, 35, Adelaide Street, Fleetwood, Lancs.—Mr. F. Jackson and Mr. M. P. Tundley have dissolved partnership. Debts will be attended to by Mr. Tundley, who will continue the business.

Trade Announcements.—Messrs. J. Beer & Sons, electricians, have transferred their business to new works and offices at 76, Windsor Road, Penarth.

Messrs. Lionel Robinson & Co., 3, Staple Inn, Holborn, W.C.1. (Holborn 6323), have been appointed by the Walsall Electrical Co., London, stockholders for its two-range voltmeters, 0/10, 0/100, for measuring the filament and plate voltage of wireless valve sets.

Messrs. Aylward Bros., electricians, Bromley, Kent, have taken over the business of Mr. A. A. Hart, 55, High Street, and 6 & 7, Bank Buildings, Hastings.

Messrs. William Sanders & Co., 90, Charing Cross Road, W.C.2., announce the introduction of a new range of house service switchgear, with interlocking handle, and other special features.

Mr. H. T. Bourne, electrical contractor, has opened business premises in Whalley Range, Blackburn.

Mr. George Knight, lately inspector to the National Boiler Insurance Co., Ltd., and of Messrs. Royce, Ltd., Trafford Park, Manchester, has now joined the Stenholm Engineering Co., Lloyd's Bank Buildings, Manchester, and is in charge of its electrical department.

Messrs. Bates & Windibank, electrical engineers, Sentinel House, Southampton Row, W.C.1, have been appointed distributors for Messrs. F. & A. Parkinson, Ltd., Guiseley, makers of the "Com" type single-phase motor (manufactured under Creedy patents) and induction type single, two and three-phase motors; also for Messrs. Flather & Co., Ltd., Leeds, manufacturers of direct-current motors and dynamos.

Messrs. G. S. Peckham & Co., 4 and 5, New Compton Street, W.C.2, pointing out errors in the style and address of the firm as given in our last issue, which we regret, inform us also that they are associated with Commander R. Preston as sole agents for the British Isles and Dominions for the Swedish firms mentioned.

Private Arrangement.—Moodys, Ltd., electrical engineers and contractors, 84, Craven Park Road, Harlesden.—A meeting of the creditors of this company was held on August 28th. The company was registered on April 21st last to take over the business carried on by the brothers Moody. Each brother took 250 £1 shares, which were issued to them as fully-paid as the purchase consideration for the business, and it was stated that a Mr. Guest had taken up a further £250 in £1 shares for cash. According to the facts disclosed at the meeting the business had been losing money, and there was little or no stock in the shop, such stock as there was having been sold by the sheriff under an execution in respect of a writ which had been issued. There was about £80 in the hands of the sheriff. The liabilities to creditors were said to be about £680, and the only asset of any consequence was the book debts, which were stated to be of the value of about £170, but which might realise something less than this figure. Messrs. Moody put forward an offer of a composition of 7s. 6d. in the £, payment to be spread over a period. This was not considered satisfactory, and the meeting was adjourned with a view to giving Messrs. Moody an opportunity of finding something in the nature of a guarantee. The following are creditors:—

	£		£
Credenda Conduits	10	Times Electrical Co.	25
British Thomson-Houston Co.	25	General Electric Co.	75
Catchpole Maurice	41	Falk, Stadlemann & Co. ...	200

Catalogues and Lists.—Messrs. T. C. Jones & Co., Ltd., 93 and 95, Wood Lane, Shepherd's Bush, W.12.—A comprehensive tool catalogue giving illustrations and prices of vices, spanners, pliers, drills, lathe tools, &c.

Mr. Edgar W. Dorey, Norwich House, Southampton Street, High Holborn, W.C.1.—An illustrated descriptive pamphlet dealing with "A.B.C." semi-Diesel crude oil engines.

The K.F.M. Engineering Agencies, Ltd., 304, High Holborn, W.C.1.—A booklet describing various types of "Internalite" signs for advertising purposes.

Messrs. Justus Eck & S. Brook, 4-12, Palmer Street, Westminster, S.W.1.—An illustrated booklet describing "Kandem" a.c. meters; and a leaflet dealing with bells and signal transformers.

Messrs. Rayner & Heald, Ltd., Duke Street, Derby.—Leaflets G 101 and G 105, giving specifications, prices, &c., of two- and three-phase induction motors.

Messrs. A. Verey & Co., Ltd., 27, Buckingham Gate, Victoria Street, S.W.1.—Abridged net price list for September of electric lighting accessories and installation material.

The Alden Engine Co., Ltd., Crown Works, Oxford.—Publication No. 110, a folder illustrating a number of engines and small generating and pumping sets, and containing copies of letters from customers.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—Four priced leaflets dealing respectively with: vacuum and gas-filled lamps; "Sunco" electric fires; "Sunco" bell transformers; and desk fans.

Callender's Cable & Construction Co., Ltd., Hamilton House, Victoria Embankment, E.C.4.—A well-produced brochure dealing with "Kalanite" insulators for power transmission lines.

The Jackson Electric Stove Co., Ltd., 143, Sloane Street, S.W.1.—An illustrated folder giving particulars and reduced prices of electrical fires of various types.

The Benjamin Electric Co., Ltd., Brantwood Works, Tariff Road, Tottenham, N.17.—A revised discount list of industrial lighting fittings, automobile accessories, &c.

Messrs. A. P. Lundberg & Sons, 477-489, Liverpool Road, N.7.—List of reduced prices of switches, connectors, and other electrical accessories.

The Stanton Ironworks Co., Ltd., near Nottingham.—Stock list for September of cast-iron pipes; also a list of principal users.

Messrs. A. W. Beuttell, Ltd., 53, Victoria Street, S.W.1.—An illustrated and priced booklet dealing with "Linolite," "Tubolite," and "Beuttell" patent systems of strip lighting.

The General Electric Co., Ltd. Magnet House, Kingsway, W.C.2.—"Reasons Why," No. 4, an illustrated card, dealing with the merits of quick-make and quick-break tumbler switches.

Also No. 5, illustrating and describing B.E.S.A. wall plugs.

Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, S.W.1.—Stock list (in French) of motors and dynamos (September).

The Arora Co., Loughborough, Leicestershire.—An illustrated and priced pamphlet dealing with new designs of electric fires.

Mr. S. Utting, 82, Victoria Street, S.W.1.—Booklet on the "Thermix" air heater for recovering heat from flue gases, containing also technical data, &c.

Messrs. Crowther & Osborn, Ltd., 7, Blackfriars Street, Salford, Manchester.—A revised price list of "Sceando" m.f. lamps.

Lead Report.—James Forster & Co.'s report dated September 2nd says: Closing prices yesterday were £24 5s. for August and £23 12s. 6d. for November, against £23 7s. 6d. and £22 15s. respectively at the end of last week.

Transactions have again been fairly large, but not on the scale of the previous two weeks. The total this week is round about 4,000 tons, against 5,500 last week. The tone has been firm throughout the week. The arrivals for August are about 17,000 tons, a quantity far in excess of actual needs. In consumption, the only active trade is in accumulators, which is quite good. Cable makers are not using as much as they were.

Local Exhibitions.—Messrs. F. J. Jones & Sons, Ltd., electrical engineers, Chester, were awarded the gold medal for the most imposing stand at the Cheshire Agricultural Show last week. Their exhibit was of large dimensions, and the electric sign lights arrested the attention of crowds of visitors. Messrs. F. J. Jones exhibited about 20 lighting sets, of various sizes. Electrically-driven water pumps for the house and farm included an example which would give water service from a well equal to any town supply. A portable standard power set for driving farm and domestic machines was exhibited. The "Kaleeco" system of wiring was shown. Other exhibits were:—The "Briarton" washing machine, an electric geyser for fixing to an ordinary water tap for heating water, and an "Adjusto" light, which can be used for reading in the drawing room, for the dressing or bathroom, and for reading in bed. Many examples of art shades were shown, and a portion of the stand was set apart to form a lounge electrically lit and heated. There were wireless attractions at Messrs. F. J. Jones & Sons, and Messrs. Williams, Gamon & Co.'s stands. The instruments were made by the W. J. W. Radio Co., of Milton Street, and five valve receiving sets, complete with loud speakers, were on view and working at each of the two stands. A bronze medal was conferred upon Messrs Williams, Gamon & Co. (Kaleyards), Ltd., Chester, for their display of electrical plant and fittings.

At the Shrewsbury Trades Exhibition Messrs. W. Thomasson & Co., of High Street, had a fine display of electrical goods and wireless instruments. Wireless demonstrations were given daily at their stand under the personal supervision of a special representative of Marconi's Wireless Telegraph Co., Ltd.

Trieste Sample Fair.—The Duke of Genoa opened the Sample Fair on September 3rd, the Minister for Posts delivered the opening address. The Duke afterwards made a tour of the stands, showing particular interest in the Colonial stand and the wireless exhibit of the Marconi Co.—*Reuter* (Trieste).

Book Notices.—"The Mechanism of Lubrication," by William Stone. (40 pp.). London: *Industrial Australian and Mining Standard*. Price 2s. 6d.—This is stated to be a popular explanation of the principles of lubrication as developed mathematically by Reynolds and Michell, and employed by the latter in the design of the well-known Michell thrust and journal bearings. Professor R. W. Chapman, of Adelaide University, has written an introduction, and the treatise is well illustrated by means of photographs and diagrams.

The *Journal* of the Junior Institution of Engineers, Vol. XXXII, Part 11, September. London: Percival Marshall and Co. Price 2s.—The principal feature of this number is a paper on "Anti-friction Bearings," by G. W. C. Webb, O.B.E. An index to Vol. XXXII is included, together with notes of proceedings.

Messrs. Benn Brothers will publish during September the third volume of Mr. H. H. Broughton's "Electrical Handling of Materials," entitled "Electric Cranes."—This volume, to which the two already published are introductory, deals in the most comprehensive manner with every kind of crane and crane mechanism. There are some 300 illustrations and 65 tables.

"The Construction of Wireless Receiving Apparatus," by P. D. Tyers. Pp. vii+76, figs. 28; price 1s. 6d. net. "Wireless Valves Simply Explained," by J. Scott-Taggart. Pp. v +134; figs. 56; price 2s. 6d. net. London: Radio Press, Ltd., and Sir Isaac Pitman & Sons, Ltd.

"Hand Book of the Electric Power Club of Cleveland, U.S.A." Pp. 284. Cleveland, U.S.A.: The Club. Price 50 cents.

The *Transactions* of the South African Institute of Electrical Engineers, Vol. XIII, part 5, July.—Included in this number are: "Notes on Synchronous Converters," by P. Fraser; replies to discussions on "Reinforced Concrete Poles for Overhead Line and Traction Work," by B. Sankey, and "Notes on Radiography," by H. G. Symons; and many notes of proceedings.

Trade with Germany.—Mr. J. W. F. Thelwall, Commercial Secretary to H.M. Embassy in Berlin, will be in attendance at the Department of Overseas Trade from September 11th until September 16th, where he will be pleased to interview manufacturers and merchants interested in trade with Germany. Applications for appointments with Mr. Thelwall should be made at once, and addressed to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. The reference 3905/TG/GP should be quoted in all cases.

Weldrics, Ltd., v. Quasi-Arc Co., Ltd.—We learn from Messrs. Weldrics that some misunderstanding has arisen with regard to their action against the Quasi-Arc Co., Ltd., a report of which appeared in our issue of June 30th, some readers having supposed that the question whether there was infringement of the latter's patents by the electrodes made by the former was not settled. This, however, was not the case; according to the official report published by the Patent Office, Mr. J. Hunter Gray, K.C., for the Quasi-Arc Co. (the defendants), said that the only electrode that the plaintiffs had ever made had been admitted not to be an infringement, and that the admission of non-infringement had never been withdrawn. In the course of his judgment, Mr. Justice Eve said: "The circular stated that it had been held that electrodes in which blue asbestos was partly used as a covering constituted an infringement of the company's patents. It had not, in fact, so been held." His Lordship proceed to explain that Messrs. Weldrics applied pulverised blue asbestos as an ingredient in a paste with which the electrodes were covered, and he showed from the correspondence which was put in evidence that the Quasi-Arc Co. did not assert that the electrode covered with the paste was an infringement, but limited their claim to the use of blue asbestos in the form of yarn.

Annual Outings.—The employés of the Glasgow and South-Western Railway Co.'s electrical department held their first annual excursion on September 2nd, accompanied by the Chief Electrician (Mr. George Thomson) and the Chief Inspector of Plant and Machinery (Mr. H. Urquhart). The party, from all parts of the G. & S.W. system, met at Glasgow, and proceeded by train to Craigendoran, thence by steamer to Anochar, luncheon being provided on the steamer. Walking across to Tarbet, Loch Lomond, the party embarked on the *Prince George*, and sailed down Loch Lomond to Balloch, where tea was served. The party was favoured by excellent weather, and arrived back in Glasgow about 7.30 p.m.

Norwegian Agencies.—The Commercial Secretary to H.M. Legation at Christiania has forwarded to the Department of Overseas Trade a list of Norwegian agents seeking connections with British manufacturers and exporters of a large variety of commodities, including textiles, chemicals, hardware, coal, iron, and steel, provisions, &c. Interested British firms or individuals who are desirous of appointing agents in Norway should make application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1 (quoting Reference Number D.O.T./F.R./5840).—*Board of Trade Journal.*

Wages in the Electricity Supply Industry.—In view of rumours current with respect to further wage decreases in the London area electricity undertakings, the Marylebone branch of the National Amalgamated Union of Enginemen and Electrical Workers, at a meeting held on September 1st, passed the following resolutions, and gave instructions for them to be circulated so that common action might be taken:—

That as the wage cuts put into operation have already amounted to about 30s. per week on the average and have brought down the wages of some grades below the £3 limit, there shall be no further cuts in wages. The so-called fall in the cost of the vital necessaries of life is viewed by this branch with suspicion and distrust, as men in many grades will be driven below the poverty line if the falls go down much below £3, and will have to seek parish relief to eke out their scanty wages to ensure their children being fed and rents duly paid.

That this branch regards the still continued high charges for electricity as tantamount to a breach of faith with the public in view of the fact that prices were rapidly advanced when wage increases took place, but have not been generally lowered in similar proportions now that the employés in the London area alone have lost many hundreds of thousands of pounds through wage cuts. The branch is of opinion that the vast profits disclosed in the published balance sheets of electricity supply undertakings show the urgent necessity for a re-adjustment of prices to the consumer, to bring these charges into line with the sacrifices the men have made to ensure reduced working costs.

That a protest be lodged against the Executive Officers of the supply stations and undertakings being allowed to retain their war wages and allowances and increases due to war conditions while the men's wages are being lowered.

Other resolutions stipulate that no revision of the Schedule (if such be submitted by the employers) shall be entertained by the J.I.C. delegates before submitting it to the rank and file, and that stabilisation of wages for the London area as a separate section shall be pressed for on the lines of the Railway Shopmen's Award 728, dated July 8th, 1922, with modifications suitable to the electricity supply industry.

The Prague Samples Fair.—This Fair was opened on September 3rd. There are about 2,260 exhibitors, including two thousand Czecho-Slovakian firms.

Vulcanised Fibre.—The Committee appointed under Part II of the Safeguarding of Industries Act, 1921, with regard to vulcanised fibre, has arranged to hold its next sitting for the taking of evidence at 12 noon, on Tuesday, September 12th, at 5, Old Palace Yard, Westminster, S.W.1.

German Glow Lamp Prices.—The Glow-lamp works included in the Central Union of the German electro-technical industry have decided to double the basic prices introduced on July 31st.

Calendar.—The British Aluminium Co., Ltd., 109, Queen Victoria Street, E.C.4, has sent us a calendar for September, 1922, to August, 1923, bearing illustrations of a variety of aluminium sections.

Osram Lamps—Price Reductions.—Pre-War Prices.—As we go to press we learn that the prices of Osram lamps have been brought down below the pre-war level. The reductions vary from 12½ per cent. to 30 per cent. for the various sizes:—

Osram Vacuum Lamps.

		Old price.	Reduced price.
Low voltage.			
100, 105, 110, 115, 120, 125, and 130 volts ...	10, 20, and 30 watts	from 2s. 6d.	to 2s. 2d.
do. do. ...	40 and 60 watts	„ 2s. 9d.	to 2s. 2d.
High voltage.			
200, 205, 210, 220, 225, 230, 240, 250 and 260 volts	20 watts ...	„ 3s. 3d.	to 2s. 9d.
do. do. ...	30, 40 and 60 watts	„ 3s. 0d.	to 2s. 6d.

Osram Gasfilled Lamps.

Low voltage.			
100. 105, 110, 115, 120, 125 and 130 volts ...	30 watts ...	„ 4s. 0d.	to 3s. 0d.
do. do. ...	40 watts ...	„ 4s. 0d.	to 3s. 0d.
do. do. ...	60 watts ...	„ 4s. 6d.	to 3s. 6d.
do. do. ...	100 watts ...	„ 7s. 6d.	to 6s. 0d.
High voltage.			
200, 205, 210, 220, 225, 230, 240, 250 and 260 volts	40 watts ...	„ 5s. 0d.	to 3s. 6d.
do. do. ...	60 watts ...	„ 5s. 6d.	to 4s. 0d.
do. do. ...	100 watts ...	„ 7s. 6d.	to 6s. 0d.

This remarkable result, we understand, has been achieved by means of improvements in machinery and methods of construction and by greatly increased manufacturing facilities at the specialised Osram G.E.C. factory at Hammersmith, coupled with an enhanced demand for electric lamps due to the growing popularity of electricity as an illuminant.

For Sale.—Woolwich Borough Council electricity department has for disposal surplus electric and steam generating plant, &c.

LIGHTING AND POWER NOTES.

Australia.—The Morwell Scheme.—The following particulars relating to the Morwell scheme have been forwarded to the Department of Overseas Trade by H.M. Senior Trade Commissioner in Australia in continuation of the report issued by the Department in April last:—All the principal contracts for the plant and machinery for the main power station at Yallourn have been placed, and the reports indicate that the progress with the manufacture of the machinery is good. A considerable portion of the transformers, switchgear, &c., has already been delivered, while the manufacture of the five large turbo-alternators and of the condensing plant, which is being supplied by Thompson & Co., Castlemaine, Victoria, is well advanced. The greater part of the preparatory work of the site has been completed; the contractors for the steel work for the power station are at work on the ground, and steel work is now arriving. Gangs have been organised for the erection of the transmission line (over a distance of 112 miles) for which much of the material has now arrived. The erection of the auxiliary station at Newport is proceeding satisfactorily and justifies the anticipation that the station will be in operation by May, 1923, as originally intended. On the coal-winning operations, the removal of overburden has already commenced, and it is expected that the winning of coal will be commenced by the end of this year. A considerable portion of the briquetting machinery is now arriving. Much work has been done at the site in preparing foundations for the plant and machinery which is expected to be operating by the end of 1923. The Government has authorised the erection of a model township at Yallourn, the site of the works, and this is being put in hand with all speed. The township scheme, which is estimated to cost £224,000 provides, in its first stages, for accommodation being made available for the Commission's employés by the erection of 200 tenements, but the final scheme makes provision for a population of 3,000.

Bath (N.S.W.).—The Municipal Council is applying for sanction to borrow £40,000 in connection with the scheme for supplying electricity to the town.

Amesbury.—Street Lighting.—The Parish Council has decided to adopt a scheme put forward by the Electric Lighting Co. for illuminating the streets by electricity. The company hopes that the arrangements will be completed by October.

Belfast.—Visit to Gennevilliers.—At the monthly meeting of the Corporation it was decided to send delegates to the visit which is to be made to the Gennevilliers Power Station next month. The Belfast representatives will include the chairman and the deputy chairman of the Electricity Committee, the Town Clerk, the City Surveyor, and the City Electrical Engineer.

Barrow.—Supply to Rampside.—The Highways Committee has approved of a proposal that the cables on the open front for the supply of electricity to Rampside be laid underground instead of being erected on poles, as was at first suggested.

Burnham (Berks.).—Electric Lighting Canvass.—The Parish Council has appointed a committee to obtain information relative to a supply of electricity for the parish. The Slough and Datchet Electric Light Co. asserts that a canvass made of the parish was not satisfactory, but the Council contends that the company did not make a proper canvass.

Burnley.—Year's Working.—The report of the electrical engineer (Mr. J. E. Starkie) for the year ended March 31st, 1922, records a total revenue of £88,495, comparing with £75,255 in the previous year. Working expenses totalled £70,170, as against £60,178, leaving a gross balance of £18,325 (£15,077). The net result after payment of sinking fund, interest charges, &c., was a profit of £916; in 1921-22 there was a net loss of £540. A total of £92,539 was spent on capital account during the year. This included £78,692 for machinery, and £11,684 for mains and services. The number of kWh sold decreased from 7,594,107 to 7,423,557 but the maximum load increased from 3,375 to 3,418 kW. Owing to the poor quality of the fuel obtained during the coal stoppage, the fuel consumption, for a smaller output, was about 2,000 tons more than in 1921. A schedule of prices included in the report shows a small all-round increase.

Continental.—Denmark.—The Danish Committee which last year investigated the possibilities of Danish hydro-electric works reached the conclusion that the erection of seven works in Jutland, which would be able to meet 60 per cent. of the consumption in Jutland, could be carried out with advantage. It was calculated that the expenditure on the seven works would amount to 30,000,000 kronen, and the price to be charged would be from 10 to 15 ore per kWh. Seeing that a high-pressure cable from Norway to Jutland would involve an outlay of about 50,000,000 kronen, it is stated that it would be disadvantageous to procure a supply from such a distance. Since the publication of the report of the committee the question of the rational utilisation of the peat bogs in Denmark has assumed prominence. Mr. G. Cregersen, of the Danish Technological Institute,

points in this connection to the favourable results obtained in Germany. The experience gained with the latter, it is said, suggests that similar generating stations should be established at the peat bogs in Denmark.

Poland.—The Union of Polish Electrical Undertakings is reported to have prepared a scheme of works, which are considered to be of an urgent nature. Among others the scheme, which it is hoped to carry out with the aid of foreign capitalists, provides for the construction of a central station at Boryslaw, together with electric railways in this oil region.

France.—Steps are being taken to set up a rural distribution network to supply nine communes in the département of Calvados. The electricity will probably be obtained from the city of Caen. Messrs. Langeons & Geneslay, electricians, have applied for mayoral permission to cross two intervening communes for the purpose.

The Société d'Intérêt Collectif Agricole de Sandemont et Environs has applied for a concession to supply electricity to ten communes in the Pas-de-Calais département and two communes in the Département du Nord.

Italy.—The Società Elettrica del Piacentino has been formed at Salerno to utilise the River Piacentino for the production and distribution of electricity. The capital of the company is 250,000 lire.

Darwen.—Reduction of Meter Rent.—The Electricity Committee has decided that meter rentals shall be reduced 50 per cent., as from July 1st, and that the matter be reconsidered after the September balance sheet has been received.

East Grinstead.—Proposed Electricity Scheme.—By the casting vote of the chairman, the Urban Council recently adopted a report upon the proposed electricity scheme. It was shown that the income for the first year would be about £1,678, and working expenses £1,180, giving a gross profit of £498. The capital expenditure would amount to £20,000. Loan interest and repayment would be £1,600.

Elland.—Year's Working.—The Electricity Committee reports that the profit earned during the year 1921-22 was over £3,000; in the previous year a deficit of £2,000 was incurred. The Committee recommends a reduction of 12½ per cent. in the present charge of 8d. per kWh.

India.—Ootacamund.—The Municipal Council recently considered an offer of the Nilgiri Power Syndicate to supply the district with electricity, but decided to allow the Metropolitan-Vickers Co. to install a distribution scheme and provide a temporary supply from the Cordite factory at Aravangadu.

Knaresborough.—Workhouse Lighting.—The Board of Guardians has appointed a committee to consider the question of having electric lighting installed at the workhouse. The Harrogate Town Council has offered a supply with a minimum payment of £425 per annum for four years, or £300 per annum for five years.

Llanelly.—Accident.—Four men employed by the Llanelly Electric Lighting & Traction Co. on August 29th were dismantling an electric light standard in the Town Hall Square. The standard was lashed to a lowering wagon, and two men were at the top of it when it collapsed and they were thrown to the ground, one fracturing his elbow and the other sustaining injuries to the hip, which necessitated medical attention.

Lyme Regis.—Proposed Electricity Supply.—At a recent meeting of the Town Council a draft Order which the Electricity Commissioners proposed to issue was discussed. It was stated that the maximum price chargeable had been lowered, but the Mayor explained that the lower rate at which money was now obtainable would more than compensate for this. It was hoped that the objection to the erection of overhead lines would be overcome as underground cables would entail considerable expense.

Masham.—Proposed Price Increase.—The Urban Council has applied to the Electricity Commissioners for an order permitting it to increase the maximum charges for electricity from 8d. per unit to 9d. for lighting, and to 4½d. per unit for power, with minimum payments of 11s. 3d. for the winter quarters, and 7s. 6d. for the summer quarters.

New Zealand.—Devonport.—Application is being made for sanction to borrow £40,000 in connection with the electricity scheme for the district.

Okehampton.—Proposed Purchase of Undertaking.—The Town Council has instructed the Town Clerk to communicate with Messrs. Nicholls & Unwin for the purpose of arranging with them to advise the Council as to the advisability of purchasing the Okehampton electric light undertaking, and to make the necessary valuations, &c.

Seaton.—Proposed Electricity Supply.—Steps are being taken to ascertain the views of residents as to the advisability of instituting a scheme of electricity supply. There are a number of private installations in the town, but although the Council has discussed the matter at various times no definite move has been made.

Spenborough.—Loan.—The Urban District Council has decided to apply for a loan of £7,675 to carry out a scheme of electricity supply to Scholes, and to make the necessary sub-station arrangements.

St. Annes-on-Sea.—Proposed Extensions.—The Urban District Council has deputed the electrical engineer (Mr. J. H. Clothier) and a member of the Council, to confer with the Electricity Commissioners respecting extensions of plant at the electricity works.

Portmadoc.—Electricity Supply.—The North Wales Power Co. has obtained the consent of the Council to erect transmission poles and wires within the local area from Cwm Dyli *via* Tremadoc, to Criccieth.

Stalybridge.—Loan.—The Generating Station Committee of the Stalybridge, Hyde, Mossley, and Dukinfield Joint Tramways and Electricity Board has recommended, and the Board has approved, application for sanction to borrow £44,700 to carry out plant extensions which have become urgently necessary.

Wrexham.—Mutual Supply Scheme.—The Town Council has arranged with the Gresford Colliery to receive or give a supply of electricity as necessary. It is hoped to have the mains laid for this purpose by December next.

The British Thomson-Houston Co., Ltd., has been awarded the contract for the supply and erection of a rotary converter and switchgear at a total cost of £2,564.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—Year's Working.—The 1921-22 report of the municipal tramway department (manager: Mr. Wm. Forbes) shows a total income of £184,618, comparing with £191,470 in the previous year. Working expenses amounted to £137,979, as against £157,585, leaving a gross profit of £46,639 (£33,885). Interest, sinking fund, depreciation, &c., absorbed £31,550, as against £32,304, giving a net profit of £15,089, as compared with £1,581 in 1920-21. Capital expenditure during the year amounted to £7,890, mainly on the construction of new cars and permanent way. There was a decrease in traffic; the passengers carried numbered 41,087,388, as against 42,953,807; the car mileage fell from 2,307,259 to 2,252,889. The motor omnibuses earned a net profit of £771.

Barrow.—Inquiry.—It is proposed to hold an inquiry into the working and control of the tramway undertaking.

Bristol.—Acquisition of Tramways.—During the present month a committee of the Corporation is to consider the question of acquiring the tramways at the next date of option.

Burnley.—Year's Working.—The 1921-22 accounts of the municipal tramways department (general manager: Mr. H. Mozley) record a total income from all sources of £163,058, as compared with £180,792 in the previous year. Working expenses totalled £144,632, as against £168,140, leaving a gross profit of £18,426 (£12,652). The payment of capital and other charges absorbed £20,740, causing a net deficit of £2,314—a large reduction upon the previous year's debit of £9,752. The traffic statistics showed a decrease; passengers carried from 23,407,356 to 19,164,508, and car-miles run from 1,774,198 to 1,522,278. The report of the general manager states that the coal miners' dispute had serious effects upon the undertaking, causing a net loss of £13,000. The arrears of repairs caused by the war were considerably reduced. The necessity to relay greater lengths of track had also had an adverse effect upon the traffic.

Continental.—Germany.—The growth in working expenses of the electric tramways at Gerthe and Hoerde, Westphalia, threatens to bring these lines to a complete standstill. Wages and raw materials have reached such a level that it is thought to be no longer possible further to raise the fares to meet the higher working expenses, the wages of the tramway employés alone having now advanced to 37½ marks per hour at Gerthe. The owners of the Hoerde district lines have already applied for permission to discontinue the services.

India.—Proposed Tube Railways.—The office of the High Commissioner for India has forwarded to the Department of Overseas Trade copies of reports on the proposed tube railways between the East Indian Railway and the Eastern Bengal Railway, together with a book of plans and a longitudinal section. These documents can be inspected by representatives of United Kingdom firms interested on application to Room 49 of the Department of Overseas Trade, 35, Old Queen Street, Westminster, London, S.W.1, until September 20th next, after which date they will be available for loan in order of application to firms in the Provinces which are unable to have them inspected in London. (Ref. 9,262/E.D./E.P.)

London.—Post Office Railway.—The Minister of Transport has extended the time of the Post Office (London) Railway Act, 1913, for the completion of the railway and works, until August, 1924.

Central London Railway.—The Minister of Transport has extended the time of the Central London Railway Act, 1914, for the completion of the enlargement of the tunnels until July, 1924.

Manchester.—Result of Fare Reduction.—The reduction of fares has caused a considerable loss to the Corporation during the past two or three months. The Corporation has asked the general manager to submit a report with recommendations.

Southport.—Extension of Time.—The Minister of Transport has extended the time until August, 1923, of the Southport Corporation Act, 1913, for the completion of the electrical equipment for the working of trolley vehicles.

Sunderland.—Proposed Wages Reduction.—In view of the proposed reduction of 12s. per week in tramwaymen's wages, the Tramways Committee, being of opinion that the question is one for local settlement, has recommended the Town Council to secede from the Joint Industrial Council for the tramway industry.

United States.—New York Subway Accident.—Last week a man was killed and 25 people were injured by an accident on the Hudson (New York) Tube. A crowded train was standing on a line on account of some signal trouble when a following train crashed into its rear.

TELEGRAPH AND TELEPHONE NOTES.

Atlantic Cables.—Normal Service.—The Western Union Telegraph Co. announces that it has made considerable improvements in the facilities since August 7th, when all communication through Valentia was interrupted by the action of the Irish Irregulars. These improvements have resulted in a normal service being given to full-rate messages, and the company is now able to accept deferred or cheap-rate messages under the usual conditions.

In connection with last week's statement by the Irish Provisional Government, with reference to the cutting of a transatlantic cable at Valentia, the Western Union Telegraph Co. states that no cable has been cut, although a certain amount of damage has been done at the cable station, which will take some days to repair.—*Daily Telegraph.*

Australia.—New Loan.—The House of Representatives on August 31st passed a Bill authorising the raising of a loan of £17,000,000, of which £3,000,000 will be allocated for postal, telegraph and telephone works.—*Reuter's Trade Service* (Melbourne).

Wireless Board.—The Commonwealth Cabinet has appointed the Prime Minister as the seventh member of the board which is to install and control direct wireless communication between Australia and the United Kingdom. The board will choose a chairman, who, it is expected, will be the Prime Minister. The Commonwealth Government and the Amalgamated Wireless Co., which is to install the service, each had three directors on the joint board, but were unable to agree on the seventh, and the arbitrator under the agreement selected Sir Thomas Hughes, chairman of the Amalgamated Wireless Co., thus giving the company a majority. There was an outcry in Parliament, and Sir Thomas Hughes resigned.—*The Times.*

New Wireless Stations.—The Commonwealth Prime Minister has promised to inquire into the matter of tenders for the construction of the stations required to establish the new Commonwealth wireless scheme. A member of the House, in bringing the matter to the notice of the Prime Minister, suggested that tenders for the erection of the necessary stations should be made open to public competition.—*Reuter's Trade Service.*

Brazil.—New U.S.-Brazil Cable.—The Western Telegraph Co. was to open a new direct cable route to the United States on September 7th. It appears that this question, which during the past two years has raised difficult international controversies, has been definitely settled, and local commercial interests are greatly pleased that increased facilities for cable communication are to be made available.

British Columbia.—New Wireless Station.—It has been decided to install a wireless station at Stewart in place of the present telegraph station.—*Reuter's Trade Service* (Stewart).

Denmark.—Telephone Tariff Reductions.—The telephone tariff in Copenhagen is being reduced by about 10 per cent., from 150 to 136 kroner per annum for 1,000 calls, and from 300 to 270 kroner for the unlimited service. In the provincial towns of Zealand the charge is reduced from 100 kroner to 90, and in rural areas from 90 to 80 kroner. Distance charges are also reduced proportionately.—*Financial Times.*

France.—New Wireless Station.—The Société Francaise Radio-Electrique has been entrusted with the work of equipping the wireless station at La Fayette, near Bordeaux. The same type of machines will be used as those employed at the Sainte-Assise station, which was recently opened for service.

Germany.—Wireless Telephony.—A central wireless telephone office has been opened in Berlin in connection with the wireless station at Königswüsterhausen for an express service of financial news to subscribers.—*The Times.*

Hitherto the general public has not been allowed to have wireless installations, says the *Daily Mail*, but it has been arranged to supply subscribers in 140 cities with a service of business news by wireless telephone. At the central office in Berlin news will be spoken into a microphone apparatus connected with the chief wireless station at the Imperial post office at Königs Wusterhausen, where the news will be broadcast throughout Germany by an automatic wireless telephone sender. The subscribers to the service will be provided with apparatus by the post office, the annual payment for which will be not less than 4,000 marks, or 15 shillings. Later in the autumn it is intended to send out instructive and entertaining lectures and concerts by wireless telephone every evening.

Portugal.—Wireless Concession.—A Bill has been placed before the Portuguese Parliament to authorise the formation of a Portuguese company for the establishment of a system of wireless telephony and telegraphy between Lisbon and the Colonies. A maximum period of four years is fixed for the completion of the work. The granting of the concession to the Marconi Co. was referred to in our August 25th issue.

Sweden.—Foreign Telephone Contracts.—M. Winkrantz, a director of the H. T. Cedergren Co., who has returned from a visit to Poland, Austria, Italy, and Spain, states that the agreement with the Polish Government regarding the new Polish Telephone Co. may be regarded as definitive, and that the co-operation with the Poles is good. In Spain an agreement has been entered into regarding the taking over of the telephone station of Valencia and its surroundings. The negotiations with the Italians relating to the taking over of the telephones at Verona have not yet resulted in an agreement. M. Winkrantz, however, is very satisfied with the company's position in all these countries.—*Reuter's Trade Service* (Stockholm).

United States.—Cable Companies' Alliance.—It is announced that an alliance has been formed between the Postal Telegraph Co. (part of the Commercial Cable system) and All-America Cables, Incorporated. Fifty thousand miles of submarine cables are involved.—*Reuter's Trade Service* (New York).

Wireless Telegraphy.—Reception on Trains.—According to *The Times* engineers have made experiments in the reception of wireless messages on board a railway train on the Paris-Orleans line. They employed the electric light wire as receiving wire, and between Limoges and Châteauroux they were able to pick up clearly messages from Greenwich. Later messages from the French station at Saint-Assise were received. The engineers arrived at the conclusion that with a special wire on the roof of the carriage it would be easy to hear the wireless telephone messages from the Eiffel Tower.

Restoration of Deferred Service.—It was announced on the 5th inst. that the deferred (l.c.o.) Marconi wireless service to the U.S.A., South America, &c., which was suspended when the Clifden wireless station was damaged by the Irish irregular troops a few weeks ago, had been restored.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—Victorian Electricity Commissioners. January 15th, 1923. Four water-tube boilers, each 4,500 sq. ft., with pumps, piping, and structural steelwork for boiler-house.

January 23rd. Back-pressure steam turbine, including a 1,500-kW alternator.

Sydney.—October 23rd. Municipal Council. Two thousand 240-V, d.c. and 25,000 240-V single-phase electricity meters.

October 23rd. Minister of Public Works. Two water-turbines and generators in connection with the Barren Jack hydro-electric development. (See this issue.)

ADELAIDE, SOUTH AUSTRALIA.—December 5th. Adelaide Electric Supply Co., Ltd. 380 electric motors.—*Reuter's Trade Service* (Adelaide).

Victorian Railways.—With reference to our note on p. 309, September 1st, for three electric storage battery industrial trucks, *Reuter's Trade Service* (Melbourne) states it is understood that the order will be placed locally.

Belfast. — September 11th. Electricity Department. Stores (including wires, cable, lamps, electrical accessories, &c.) for six months. (August 25th.)

September 22nd. Tramways Committee. Reconstruction of 10 miles of single track. (See this issue.)

September 26th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, &c., for five months. (See this issue.)

Belgium.—September 20th. The municipal authorities of Ixelles, Brussels. Armoured cable for low-pressure distribution mains.

Birmingham.—September 29th. Electricity Committee. Nechells generating station. Power-driven lathes, machine tools, shafting and pulleys. Mr. E. J. Jennings, secretary, City Electric Supply Department, 14, Dale Street.

Brentford.—September 25th. Board of Guardians. Six months' supply electric lamps and accessories. Mr. F. E. Harmsworth, clerk, 24, Twickenham Road, Isleworth.

Bristol.—September 13th. Board of Guardians. Electrical fittings for six months. Mr. J. J. Simpson, clerk, St. Peter's Hospital.

Bulgaria.—SOFIA.—October 16th. Directorate of Post, Telegraph and Telephone. Telephone cable and materials.*

Conisborough.—September 18th. Urban District Council. Wiring, &c., Council offices. H. Thirlwell, surveyor.

Egypt.—CAIRO.—September 11th. Ministry of Public Works. Installation of switchboard and system of armoured feeders for works of the Palais de Ras el Tine, Alexandria.

September 30th. Electric pump, accumulator plates, and a 3-phase transformer, for the Asite des Aliénés, Khanka. Engineer-Electrician-in-Chief, Electrical Service. Ministry of Public Works, Cairo.—*Reuter's Trade Service* (Cairo).

Federated Malay States.—The Government of the Federated Malay States is inviting tenders for the electric lighting plant for the Tanjour-Malim Training College, Kuala Lumpur.—*Reuter's Trade Service* (Singapore).

French Indo-China.—September 14th. Supply of copper and bronze wire, galvanised iron and steel wire for the telegraph and telephone service of Indo China. Office National du Commerce Extérieur, 22-24, Avenue Victor-Emmanuel III, Paris.

Hastings.—October 4th. Board of Guardians. Electric lift at Frederick Road Infirmary. Mr. G. Bumstead, clerk to Board of Guardians, Union Offices.

Leeds.—September 12th. Tramways Department. Reconstruction of tramway track, Woodhouse Lane and Cookridge Street. Mr. J. B. Hamilton, general and commercial manager, 1, Swinegate.

London.—COUNTY OF LONDON ELECTRIC SUPPLY CO.—October 18th. Supply and erection of steam turbo-alternators for the Barking power station. (August 25th.)

EDMONTON.—September 14th. Board of Guardians. Six months' supply of electric lamps. Mr. E. Ridley, clerk, 77, Bridport Road, Edmonton, N.18.

BERMONDSEY.—September 14th. Board of Guardians. Six months' supply of electric lamps. Mr. H. H. Reeve, clerk, 283, Tooley Street, S.E.

WESTMINSTER.—September 13th. Board of Guardians. Supply of electric lamps, fittings, &c. Mr. W. J. Lickley, clerk to the Guardians, Princes Row, Buckingham Palace Road, S.W.

ISLINGTON.—September 12th. Board of Guardians. Electrical supplies for six months. Mr. Albert King, Guardians' offices, St. John's Road, Upper Holloway, N.19.

FULHAM.—September 20th. Electricity Department. 11,000-V switchgear, 2-phase and 3-phase. (See this issue.)

Manchester.—September 12th. Tramways Committee. Steel girder tramway rails; general stores; permanent-way special track work. Mr. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

Morocco.—RABAT.—September 16th. Supply of bronze wire, copper wire, and twisted copper wire for the telegraph and telephone service. Office National du Commerce Extérieur, 22-24, Avenue Victor-Emmanuel III, Paris.

Mountain Ash.—September 9th. Electrical installation: Electrical equipment of the Mountain Ash and Penrhiwceiber General Hospital, including steam generating sets, switchboards, booster, battery, all internal and external wiring, &c. Mr. John Wayne Morgan, consulting engineer, 5, Pembroke Terrace, Cardiff.

New Zealand.—AUCKLAND.—February 1st, 1923. Harbour Board. One 1-ton fixed electric crane.*

WELLINGTON.—October 24th. Public Works Department. 400 miles 19/13 S.W.G. bare h.d. copper wire for Mangahao electric power scheme.*

Plymouth.—September 12th. Electricity Department. Steam turbine-driven rotary boiler-feed pump. (August 25th.)

South Africa.—October 18th. High Commissioner. Electrification of the South African railways, Maritzburg-Glencoe power house. Equipment: Coal-handling plant, ash-handling plant, and circulating-water screening plant. Specifications from the Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2.

BLOEMFONTEIN. — September 20th. Municipal Council. 1,200 yd. of 4-core, .2 sq. in., 660-V paper-insulated armoured cable.

PRETORIA.—September 28th. Municipal Council. Electric capstans, coal elevator, ash elevator, and coal-stacking elevator.*

JOHANNESBURG. — September 27th. Municipal Council. House service meters and time switches.*

Torquay. — September 22nd. Electricity Department. Two water-tube boilers, with superheaters, economisers, chain-grate stokers, induced-draught plant, and other accessories. (See this issue.)

Warrington.—September 26th. Board of Guardians. Electrical supplies for three months for Whitecross Institution and Cottage Homes, Padgate. Mr. A. Bottomley, clerk to Guardians, Bewsey Chambers, Warrington.

*A copy of the plan, specification, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Bargoed.—Gellygaer Urban District Council. Accepted:
Steel poles and fittings.—Johnson & Phillips, Ltd.
Bare copper wire.—Johnson & Phillips.
L.p. cable and boxes.—Siemens Bros. Co., Ltd.
E.h.p. and l.p. switchgear.—General Electric Co., Ltd.
Transformers.—Fuller's Electrical Manufacturing Co.

New Zealand.—AUCKLAND.—Electricity and Tramways Committee. Four tenders were received for the supply of electrical equipment for 10 bogie tramcars:—

National Electrical and Engineering Co.	£11,131
English Electric Co., Ltd.	13,543
Metropolitan-Vickers Electrical Co., Ltd.	14,445

The first-named tender was accepted.—*Tenders.*

Pembroke.—Messrs. J. J. Armfield & Co., Ltd., have secured the contract for, and are now proceeding with the manufacture of, a Francis type water turbine and oil-pressure governor for the Narberth, Pembroke and Haverfordwest electrical works.

Salford.—Tramways Committee. Accepted:—
Tower wagon complete (£823).—Leyland Motors, Ltd.
Points and crossings (£984).—Hadfields, Ltd.

Electricity Committee. Accepted:—
L.p. lead-covered cable (£361).—Enfield Ediswan Cable Co., Ltd.
1,350 yd. l.p. lead-covered cable (£1,073).—W. T. Glover & Co., Ltd.
One 6,600-V, h.p. switch cubicle (£215).—Metropolitan-Vickers Electrical Co., Ltd.

Coal for six months. Accepted:—
7,500 tons best washed slack (£7,875).—A. Knowles & Sons, Ltd.
7,500 tons best washed slack (£7,875).—Clifton & Kersley Coal Co., Ltd.
3,500 tons best washed slack (£3,412).—Bridgwater Wharves, Ltd.

Stourbridge.—Accepted:—
Installing electric light in Stourbridge Baptist Church.—Simpson and Smith.

Wrexham.—Town Council. Accepted:—
Rotary converter (£1,981) and switchgear (£583).—British Thomson-Houston Co., Ltd.

FORTHCOMING EVENTS.

British Association for the Advancement of Science.—September 6th to September 13th. At Hull. Annual meeting.

The Nation's Food Exhibition.—September 6th to 26th. At Olympia, London.

Municipal Tramways Association.—September 13th, 14th, and 15th. At Newcastle-on-Tyne. Annual Convention.

National Association of Supervising Electricians.—Tuesday, September 12th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Presidential address by Mr. W. E. Highfield.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to queries received this week we need the names of manufacturers or suppliers of:—

Vitrosil fittings.

NOTES.

Wireless League.—The Postmaster-General has given his consent to the formation of a British Wireless League, and Mr. Y. W. P. Evans, secretary of the Manchester Wireless Club, is the hon. secretary and organiser. Among the objects of the League are:—

1.—Intercommunication between members, with a view to improving existing transmitting circuits, especially with regard to wireless telephony.

2.—Relaying of messages through stations owned by members, at times to be regulated by headquarters, the object of which will be the efficient organisation of all amateur transmitting stations, whereby a service of excellent utility will be maintained. All messages shall be confined to the business of the League.

3.—Strict observance of all the laws and regulations applicable to wireless telegraphy and telephony, in order that facilities may be obtained from time to time from the P.M.G.

4.—Co-operation with wireless leagues of other countries as far as the Post Office authorities will allow.

The League will consist of members and associate members, and will be governed by a central council assisted by a provincial council. Among the rules is one which says that members are expected "to police the air" as regards amateur transmission, and report any flagrant breach of rules to headquarters.

Mr. Harold Green has accepted the office of president, and Mr. W. H. Lamb is the treasurer. Information will be supplied by the hon. secretary, 2, Parkside Road, Princess Road, Manchester.—*Daily Dispatch.*

Electric Light in Royal Palaces.—The name of the Duchess of Albany, whose death was recently announced, has always been associated in certain circles with the electric light, which was first used on the occasion of her wedding, April 27th, 1882, at Windsor Castle. Queen Victoria was more progressive than is usually supposed; and it was at Her late Majesty's suggestion that the Durbar Room, at Osborne, was illuminated entirely by deflected light, about the year 1890, not a lamp or fitting nor any source of light being noticeable—surely the earliest recorded example of this "modern" system.

Legal.—Prosecution for Theft.—A fine of £2 was imposed by the Tredegar magistrates on a labourer for stealing a quantity of electric cable, valued at one guinea, the property of the Markham Colliery Co. When defendant was questioned by a police constable, who had noticed the cable, he said he hd bought it from a dealer for the purpose of making inventions, but when the chief electrician at the colliery was sent for he immediately identified the goods.

Educational.—University of London, University College. —*Faculty of Engineering.*—The 1922-23 session commences on October 2nd. The new buildings, including the Hawksby Hydraulic Laboratory, the machine tools shop, and a new laboratory for experimental work, will be ready for use in October.

A Goldsmith entrance scholarship, tenable in the Faculty of Engineering, value £90, will be competed for in September. Applications for entry forms must be made not later than September 12th. (For full particulars see our advertisement columns to-day.)

Messrs. S. Rentell & Co. inform us that their new work "Elementary Determinants for Electrical Engineers," by Mr. H. P. Few, and the new (second) edition of "Electric Bells, Alarms, and Signalling Systems" by Mr. H. G. White, have been included in the works of reference recommended by the examiners of the City & Guilds of London Institute.

Northampton Polytechnic Institute.—For the full-time courses in engineering and technical optics a special entrance examination is to be held at the end of September; the 1922-23 session for evening courses opens on September 25th. Particulars, together with conditions of entrance, can be obtained at the Institute, or from the Principal, Dr. R. Mullineux Walmsley.

The New York Subway Fire.—Recently we commented on the circumstances attending the fire on the New York underground electric railway, when some 150 persons in the tunnel were overcome by asphyxiating gases alleged to have been derived from the liquids used in the chemical extinguishers. Our contemporary *Chemical and Metallurgical Engineering*, in its issue of July 19th, said: "It is fairly well established that a number of the victims were actually affected to a certain extent by the gases evolved from the use of carbon tetrachloride fire extinguishers. Fortunately, no one was seriously disabled. The occurrence served to emphasise the danger of the unintelligent use of this very efficacious material. Work by the Bureau of Mines has demonstrated that the decomposition products of carbon tetrachloride consist of phosgene, hydrochloric acid gas, and some times chlorine. In addition, high concentrations of tetrachloride vapour are formed when the liquid is sprayed on a heated material. Death may be caused by breathing the gases for only a short time. It is obvious that the danger of such an occurrence is considerably greater in a confined space where there is not opportunity for the diffusion of the noxious gases."

After quoting from a report of the Bureau of Mines, the journal adds: "Steps have been taken to prevent a re-occurence of such an accident by the removal of this type of extinguisher from subway cars in New York."

The report referred to, which had been issued long before the accident, states that seven to nine per cent. of carbon tetrachloride vapour mixed with air will extinguish fires. The heavy vapour tends to settle to the bottom of a room and forms a blanket on the floor. This blanketing effect on any material wet with carbon tetrachloride excludes air and so aids in extinguishing fires. Undecomposed carbon tetrachloride vapour, arising from the use of the liquid in fire extinguishers when encountered in a small, confined space will probably produce unconsciousness by its anæsthetic effect. An employé of the Bureau of Mines was overcome while using a carbon-tetrachloride fire extinguisher on an automobile burning in the open air. Two employés of the Navy Department died as the result of breathing fumes from carbon-tetrachloride that had been used when the clothes of one of them caught fire when the men were working in a very small compartment. Care must, therefore, be observed in the use of fire extinguishers of the carbon-tetrachloride type in underground fire fighting. Such extinguishers are in common use for putting out fires in and around electrical equipment, for carbon-tetrachloride is a non-conductor of electricity, and, indeed, such extinguishers should be a part of the equipment of all mine locomotives. The operator need not inhale the fumes, as electric locomotives usually are in well-ventilated entries or haulageways.

In an editorial our contemporary blamed the manufacturers for selling fire extinguishers of this kind for use under such circumstances. However, in the issue of the same journal for August 16th, the results were announced of an investigation conducted by the New York Transit Commission, from which it appears that "all the illness and suffering of passengers were caused by smoke from burning insulation aggravated by the panic and haste with which they climbed 75 feet to the street, and that no serious amount of poisonous gases was generated by the Pyrene fire extinguishers. What fumes did come from the carbon tetrachloride used in the extinguishers were so diluted as to be negligible."

In preparing this report the commission had the services of experts from the Bureau of Mines and of consulting electrical engineers.

After stating that experiments will be made to find a better extinguisher, the report says: "In the meantime our study of the result of the use of Pyrene in this instance conclusively shows that its use was in no way dangerous or even discommoding. The continued efficient operation of the subways is essential to the life of the city, and this efficient operation requires the use of some immediately available fire extinguisher in case of electric short circuits, which are always possible of occurrence. Tetrachloride is the best known and most universally accepted extinguisher for this purpose. Nothing has been discovered by the investigation to justify ordering its discontinuance."

The British Cast Iron Research Association.—The director of research in the monthly circular for September details the matters submitted to the Association for investigation. Members have sought advice on many problems and interim reports on the progress of important researches have been prepared for early issue to the members.

The *Bulletin* giving full details of the work done during the first half year of the Association's activities was issued to the members last month. The replies to the various problems submitted for advice and investigations together with preliminary reports on the fundamental researches in hand or projected indicate the earnest endeavour the Association is making to meet the technical and scientific needs of the cast iron industry.

London's Great White Way.—Still another novelty in electric signs has joined the flickergraph zone around Piccadilly Circus, which more and more is rivalling the "great white way" of Broadway in its variety of flashing advertisements. The "Scintillating Press" has made its appearance on a building in Shaftesbury Avenue. On it all sorts of messages chase or non-stop each other across. "Don't get run over by the fire engines," it said the other night, when the fire brigade was operating near the Circus. "All over now—good-night," were its parting words at about 11.15. Truly a Brighter London idea, although Mr. L. C. Mencken, the distinguished American critic, deplores this adoption by London of what he regards as one of New York's bad habits. —*Evening News.*

Broken Trolley Wire.—Two Rawmarsh men were proceeding along Corporation Street, Rotherham, on August 29th, when a trolley wire broke and fell past them giving one of the men a slight shock. The wire fell on another man but without causing him injury. A policeman moved the wire to the track by means of a walking stick, thus causing the power to be cut off.

Wireless on a Delivery Van.—An enterprising American firm is probably the first to use wireless telephony in connection with its delivery service. The firm sells bread, and its system was described in a recent issue of the *Commercial Motor*. A low aerial is fitted longitudinally to the roof of a motor van, and the "earth" is provided by a connection to the frame. Inside the van is a complete telephone receiving apparatus fitted with a three-stage amplifier and a "Magnavox" loud speaker. The firm employs the agency of the nearest "broadcasting" station to give directions to its driver. The station is requested by telephone to send out instructions on a certain wave length, the receiving set on the van is tuned to this wave length, and having received his directions, the driver can. if necessary. communicate with his headquarters by ordinary telephone. Another function fulfilled by the van is the reception of broadcast concerts, which are enjoyed by large gaterings.

This is the first application, apart from military uses, of wireless telephony to commercial vehicles we have heard of since Capt. Riall Sankey mentioned it as being feasible at the recent London Transport Congress.

Automatic Signalling.—The Mersey Railway Company has arranged for the automatic electric signalling apparatus on its system to be extended from Central Station, Liverpool, to Central Station, Birkenhead, and also as far as the Adelphi Street signal box on the line to Park Station from Hamilton Square. At present the electrical system is only applied to the under-river section of the line, *i.e.*, from Hamilton Square to the city end of James Street station, and since it was brought into operation in November of last year has proved eminently successful. It is expected that the new apparatus, which is to be installed by the Westinghouse Brake and Saxby Signal Co., Ltd., London, will be in operation before the end of the year.

Ice-making Plant at Aberdeen.—A large electrically-operated refrigerating and ice-making plant was recently put into commission by the Aberdeen Steam Trawling and Fishing Co., Ltd., in new buildings at its Poynernook premises. The machinery comprises two compressors, each driven by a 250-h.p. motor; a brine circulating pump; automatic rams for moving the ice blocks when formed; an electric travelling crane for conveying the blocks; circulating water pumps for condensing purposes; and two ice-crushing machines, driven by electric motors. The power is supplied by the Aberdeen Corporation under a special contract which ensures a 100 per cent. load factor. The daily output of ice is 150 tons.

Kinema Exhibition.—Kinemagoers who fancy that the kinematograph is the product of this generation alone are likely to be surprised if they visit Mr. Will Day's exhibition of film appliances which opened at the Science Museum, South Kensington, S.W., on August 24th.

Mr. Day, who possesses what is virtually the whole history of motion-picture portrayal, has among his remarkable collection the wax figures used in the Chinese shadow shows thousands of years before Christ. A parchment made from bullock's hide, thin as paper, was apparently stretched before a brightly burning lamp. The wax figures were manipulated after the fashion of puppets, their shadows being cast upon the parchment screen. Sir John Herschell's spinning disk, the Thaumatrope, invented in 1826, is another exhibit. On one side of the disk is a drawing of an empty kennel and on the other a dog. When the disk revolves the dog appears to jump out of the kennel. This scientific toy was commercialised by Dr. Paris, who sold it at the rate of 14 for 7s. 6d. There followed what is much the same as the Wheel of Life, the fascinating old toy.

To an Englishman, Friese-Greene, is due the credit for the real kinematograph as we know it to-day—an invention which he patented in 1889. Edison reaped the world's applause; Friese-Greene died a year ago comparatively unknown and impoverished. His orphaned sons are being cared for by Mr. Will Day. Friese-Greene invented the first film with perforated sides, the first coloured film, the first stereoscopic film, and employed the first film camera. In 1896 R. W. Paul went far towards perfecting a mechanical projector. One of the most interesting exhibits is a Latin volume, published in Rome in 1646, in which Anathasius Kircher describes his invention of a magic lantern in 1640. There are also Edison's original kinetoscope projector which, on May 1st, 1893, at the World's Fair Exhibition at Chicago, gave the first public performance of motion pictures ever shown, and the original lantern slides of George IV's Coronation procession.—*Daily Mail*.

Appointments Vacant.—Charge engineer, for the Portsmouth Corporation electricity department; resident electrical engineer and waterworks manager, for the Witney Urban District Council; switchboard attendants, for the Hackney Borough Council electricity works. (See our advertisement pages to-day.)

The Manufacture of Radio Apparatus.—The methods adopted by the American Radio & Research Corporation, Medford Hillside, Mass., U.S.A., in the manufacture of wireless apparatus, were described in a recent issue of the *American Machinist* (August 12th). The essential feature of the system is the production of a number of "units," which may either be assembled separately or combined into more complete apparatus. The frame of the "unit" is made of aluminium strip, which is first punched with three holes, and then placed on a bending machine, where each piece is formed to shape while being held upon a pin through the central hole. Rheostat coils are wound upon flat fibre strips, which are held at one end by a block which fits into a rotating chuck. The wire is wound at the correct pitch by a simple feeding gear, and during winding the core is pulled out of the block, and finally the wire is cut and a new strip inserted. Loops and bends are put into connecting wires very rapidly by small hand devices. Variometer spiders of the "basket-ball" type are punched out by an indexing machine from square sheets of fibre. The flat stampings then go to a winding machine, where they are formed into correct shape over hemispheres, and rapidly wound with insulated wire by spindles driven by small electric motors. The wire is wound under and over alternate prongs by girls, who become very expert in the operation. The riveting of the two hemispherical halves is also done by hand. All metal connections are then soldered by means of electric soldering irons. In the production of small transformers the cores are inserted in and around the coil—the coils are not wound on the core. The core stampings have a central tongue, which is bent up and thrust through the coil, alternate stampings being thrust through alternate ends, and a revolving table being used to facilitate the turning of the coil. Great ingenuity has been exercised in the assembly of small parts. For instance, the fastening of connections to an insulated panel designed for the front of three "units" is effected in the following manner: The screw connections are slipped into bushings in a base-plate, the heads of the screws being prevented from turning by a simple slotted holding device. The panel is then slipped over the screws and moved under a friction chuck, into which the nuts are placed. The chuck screws the nuts on and slips when they are right "home." Many other time-saving devices are used and the complete "units" are thoroughly tested after assembly.

Future Developments at Glasgow.—Mr. R. B. Mitchell, chief engineer of the Glasgow Electricity Department, lecturing to the Rotary Club on August 30th, traced the growth of the department since its inception, and remarked that it might be safely predicted that the recently-inaugurated station at Dalmarnock would not satisfy the requirements of the community for all time. In due course a site for another station would have to be acquired—probably in the western district of the city.

Dealing with the development of the domestic uses of electricity, Mr. Mitchell said he was optimistic enough to believe that there was a great future in that direction. The rapid growth of the use of electricity in the industrial spheres had been phenomenal, but it was more than probable that the domestic load would ultimately, and before long, be greater than the industrial load. The prospects of the domestic field were almost illimitable. Meanwhile that field had hardly been touched, but the day was not far off when the terms "Ideal Home" and "The Home Electrical" would be synonymous.

Discussing electrical heating by accumulation, Mr. Mitchell said that the solution of the problem was the provision of appliances which would accumulate energy when the generating plant was not fully loaded and release it when required by the consumer. He was glad to say that so far as the heating load was concerned there were indications that such appliances would soon be on the market. If heat-accumulating methods developed as expected the effect on supply undertakings would be of boundless importance.

Iron and Steel Institute.—The autumnal meeting of the Institute opened on September 5th in the ancient Museum of the Yorkshire Philosophical Society. The president, Mr. Francis, was in the chair, and the conference was largely attended by delegates from all over the country. The Corporation of York accorded the members a civic welcome, the place of the Lord Mayor, who was unavoidably absent, being taken by Alderman E. Walker. Mr. R. L. Wedgwood also welcomed the delegates on behalf of the chairman and directors of the North-Eastern Railway Co.

Amongst the papers read during the day probably the most interesting was that contributed by Mr. A. K. Reese, of Cardiff, who outlined the bases upon which modern blast furnace practice had been built up, and endeavoured to demonstrate that the object of modern blast furnace practice was the attainment of the greatest possible quantity consistent with quality. This view met with some opposition during the discussion which followed.

Late in the day the members of the Institute attended a film demonstration descriptive of the new McConway process for the production of steel disks by centrifugal hydraulic methods direct from molten steel.—*Daily Telegarph*.

United States Chemical Exhibition.—The National Exposition of Chemical Industries will be opened at New York on September 11th. More than 400 exhibitors have already taken space, and it is expected that 50,000 Amercian chemists and persons affiliated with the commercial side of the industry will visit the exposition. Fuel economy devices will form one of the largest features of the show, and cheaper generation of steam will be demonstrated in several new types of power-house equipment, and also improvements in systems now in use. There will be an elaborate display of fire fighting equipment.—*Reuter's Trade Service* (New York).

Explosives in Coal Mines.—"The Explosives in Coal Mines Order of August 31st, 1922," is being printed and will be placed on sale. Clause 3 of the principal Order prohibits a shot-firer from approaching or allowing any other person to approach a missed-fire shot-hole until a prescribed interval of time has elapsed; the amending Order inserts words to make it clear that *no person* may knowingly approach such a shot-hole until after the prescribed interval.

Diesel Electric Dredgers.—It is stated that tenders are being invited for four twin-screw hopper dredgers for the United States War Department. Diesel-electric propulsion is to be employed. In each boat three six-cylinder, four-cycle McIntosh & Seymour 1,000-b.h.p. engines are to be installed, driving a 700-kW, 500-volt generator. For the operation of the electric auxiliaries there will be two Diesel engine-driven generators. The vessels will be 254 ft. long, with a beam of 46 ft.—*Motor Ship.*

OUR PERSONAL COLUMN

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The salary of Mr. J. H. Clothier, electrical engineer of the St. Annes Urban District Council electricity undertaking, has been fixed at £800 per annum..

In consequence of the appointment of Mr. Mattinson as general manager of Manchester Corporation tramways, Mr. H. R. Kiernan, now chief assistant in the civil engineering department, has been made permanent way engineer, at £500 a year; and Mr. W. N. Barrett, engineering assistant, succeeds to the post of assistant permanent way engineer, at £330 a year.

Mr. R. H. Andrews, who served his articles at the Canterbury Municipal Electricity Works under Mr. C. A. Blascheck, has secured an appointment as assistant electrical engineer under the Shanghai Municipality.

Mr. E. P. Bennett, joint general manager of Simplex Conduits, Ltd., is leaving on September 26th for an extensive business tour in India, Ceylon, Burma, East Indies, Australia, New Zealand, &c., in the interests of his firm and Credenda Conduits, Ltd. He will establish new agencies in all oversea centres of importance.

The marriage took place, on August 23rd, at New Malden, of Mr. S. T. Short, A.M.I.E.E., youngest son of the late Mr. Nathaniel Short, of Waltham Cross, and Miss Dorothy May Boyd, second daughter of Mr. A. H. Boyd, of Surrey Villa, New Malden.

Mr. James Preston, rolling stock superintendent at the Cardiff Corporation electric power station, has been presented with the Special Service Cross of the British Red Cross Society in recognition of exceptional service. Some time ago a workman at the power station was caught in the cog-wheels of an elevator, and in order to save his life Mr. Preston amputated his arm with a pen knife as he was suspended in mid-air.

Mr. A. P. Ambler has resigned the position of publicity manager to the Edison Swan Electric Co., Ltd., and has joined the Dorland Advertising Agency as from September 1st. Mr. H. V. Richards has been appointed Mr. Ambler's successor with the Edison Swan Co.

A marriage has been arranged, and will shortly take place, between Mr. R. Newell Mayne, engineer and manager of the Redditch U.D.C. electricity undertaking, and Isabella Dorothea, fifth daughter of Sir John Holder, Bart., Pitmaston, Moor Green, Birmingham.

Mr. J. A. Sloane, who has been in charge of the accessories section of The Metropolitan-Vickers Electrical Co., Ltd., supply department, has resigned that position, and commenced business as a manufacturer's agent, at 49, Deansgate, Manchester. He will act as sales manager for the Ironclad Switchgear Co., Ltd , of Eccles, the Mycromet Manufacturing Co., of Oldham, and Messrs F. Pratt & Co. ("Z" fuses), of London.

Mr. E. Wilcox, lately chief assistant in the accessories section of The Metropolitan-Vickers Electrical Co., Ltd., supply department, has resigned to take up the development and manufacture of patented electrical accessories of his own design. For the time being communications should be addressed to 49, Deansgate, Manchester.

Mr. H. Tweedy, who was chief assistant in the fittings and showroom section of The Metropolitan-Vickers Electrical Co., Ltd., has resigned in order to take up the position of buyer for the lighting and heating department of Messrs. Lewes's, Liverpool. He will be pleased to receive catalogues and prices from manufacturers and agents.

Mr. T. H. Windibank, sales engineer to Messrs. City Electrical Co., and Mr. E. Hugh Bates, recently with Messrs. E. Brook, Ltd., in a similar capacity, have gone into partnership under the name of Bates & Windibank, electrical engineers, with offices at Sentinel House, Southampton Row, W.C.1. They will deal principally in a.c. and d.c. plant, and have been appointed distributors for Messrs. F. & A. Parkinson, Ltd., Guiseley, Leeds, and Messrs. Flather & Co., Ltd., Leeds.

Obituary.—Mr. J. Wordell Shemeld.—We regret to read in the *Irish Builder and Engineer* that Mr. J. Wordell Shemeld, electrical engineering contractor, of 49-53, Berry Street, Belfast, was killed while motor cycling near Portrush, his companion, who was in the sidecar, being seriously injured. The sidecar struck some stones and overturned.

Mr. F. E. Hesse.—The death occurred at his home at Richmond-on-Thames, on Tuesday last week, in his seventieth year, of Mr. F. E. Hesse, for many years general manager and secretary of the Eastern Extension, Australasia & China Telegraph Co.

NEW COMPANIES REGISTERED.

Murray & Ramsden, Ltd. (184,067).—Private company. Registered August 30th. Capital, £30,000 in £1 shares. To carry on the business of manufacturers of ebonite, vulcanite and synthetic rubber, manufacturers of and dealers in ebonite, vulcanite, rubber and rubber substitutes, accumulator cells, acid pumps, pipes, cocks, vessels, insulators and electrical appliances, reclaimers of rubber, manufacturers of, dealers and proofers of textile cloths or fabrics, chemical manufacturers, electrical and general engineers, &c. The first directors are:—G. I. Murray, South Bank, Broad Oak Park, Worsley (of G. I. Murray & Co.); G. I. Murray, junr., South Bank, Broad Oak Park, Worsley; C. S. Ramsden, Osborne House, Alderley Edge, Cheshire (managing director of Wm. Ramsden & Sons, Ltd., and director of Northern Auto-Electric Services, Ltd.). Remuneration (except managing directors) as fixed by the company. Registered office: Vulcanite Engineering Works, Carrington Field, Stockport.

Lumens, Ltd. (183,965).—Private company. Registered August 24th. Capital, £1,000 in £1 shares (500 cumulative preference and 500 ordinary). To carry on the business of manufacturers of and dealers in electrical, magnetic, telegraphic, telephonic, and other appliances and apparatus, &c. The permanent directors are:—J. B. Levee, 23, Hartley Street, Levenshulme, Manchester; H. Lomax, 11, Cathedral House, Long Millgate, Manchester (electrical engineer). Qualification: 20 shares. Registered office: 11, Cathedral House, Long Millgate, Manchester.

Napier Wireless, Ltd. (184,068).—Private company. Registered August 30th. Capital, £100 in £1 shares. To carry on the business of manufacturers of and dealers in machines, instruments, and apparatus for use in connection with telegraphy and telephony, and other modes of transmitting and receiving signals, &c. The subscribers (each with one share) are:—J. Coleman, 11, Netherford Road, Clapham, S.W.4, clerk; A. H. Palmer 49, Penshurst Road, Thornton Heath, Surrey, clerk. The subscribers are to appoint the first directors. Solicitors: Bristows, Cooke and Carpmael, 1, Copt hall Buildings, E.C.2.

Robert Crust, Ltd. (184,087).—Private company. Registered August 31st. Capital, £1,000 in £1 shares. To acquire the business of an electrical engineer carried on by R. Crust, of 40, Brook Street, Bradford. The permanent directors are:—R. Crust, 63, Norman Lane, Eccleshill, Bradford; S. W. Hill, 25, Walker Terrace, Bradford; W. A. Toppin, 111, Heaton Road, Bradford. Qualification: 50 shares. Registered office: 40, Brook Street, Bradford.

P. E. T. Luminous Ads, Ltd. (184,122).—Private company. Registered September 1st. Capital, £1,000 in 1s. shares. To carry on the business of manufacturers of and dealers in kinematographic and other films and pictures, photographic, optical, electrical and other apparatus, &c., for kinema shows, or for advertising purposes, &c. The first directors are:—F. W. Price, Dale Cottage, Merthyr Tydfil, merchant; F. Taylor, 8, Dyke Street, Merthyr Tydfil, kinematograph theatre manager. Qualification: 500 shares. Secretary: J. E. Taylor. Registered office: 3, Milbourne Chambers, Merthyr Tydfil.

C.A.V. Small Tools, Ltd. (184,095).—Private company.—Registered August 31st. Capital, £25,000 in 23,000 preference shares of £1 each and 40,000 ordinary shares of 1s. each. The objects are: to adopt an agreement between C. A. Vandervell & Co., Ltd., and F. R. Wade, and to carry on the business of manufacturers of and dealers in tools, hardware, ironmongery, &c. The subscribers (each with one preference share) are:—M. P. G. Elliott, The Laurels, Sunbury Common, Middlesex, merchant; D. D. McNeile, The Laurels, Sunbury Common, Middlesex. The governing directors are: F. R. Wade (chairman) and M. P. G. Elliott. Qualification: £100. Remuneration: £100 each per annum (chairman £200) and 10 per cent. of the profits, divided between them. Solicitors: Watson, Sons & Room, 11, Bouverie Street, E.C. No notice of situation of registered office was filed at time of incorporation.

Highfield Electrical Co., Ltd. (184,119).—Private company. Registered September 1st. Capital, £2,500 in £1 shares. To carry on business as indicated by the title. The first directors are:—F. W. Highfield, 29, Newland Road, Coventry (chairman); C. B. Lee, 4, St. Ann's Road, Stoke, Coventry; H. Beesley, Burton Green, Tile Hill, near Coventry. Qualification: £250. Secretary: H. Megainey. Solicitors: R. A. Rotherham & Co., Coventry.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dawlish Electric Light and Power Co., Ltd.—Satisfaction to the extent of £300 on May 11th, 1922, of mortgage debenture dated September 24th, 1920, securing £2,000.

Dudley, Stourbridge and District Electric Traction Co., Ltd. (14,763).—Return dated June 8th, 1922. Capital, £200,000 in £5 shares (20,000 ordinary and 20,000 preference). All shares taken up. £200,000 considered as paid. Mortgages and charges, £72,500.

Western Electric Co., Ltd. (106,921).—Return dated July 26th, 1922. Capital, £500,000 in £5 shares. 99,995 shares taken up. £155,975 paid. £344,000 considered as paid. Mortgages and charges, nil.

Johnson & Phillips, Ltd. (84,968).—Return dated June 8th, 1922. Capital, £700,000 in £1 shares. 437,500 shares taken up. £269,135 paid. £168,365 considered as paid. Mortgages and charges, £350,000.

New Gutta-Percha Co., Ltd. (74,517).—Return dated June 16th, 1922. Capital, £125,000 in 50,000 preference shares of £1 and 150,000 ordinary shares of 10s. each. 14,100 preference and 138,250 ordinary taken up. £1 per share called up on 11,350 preference and 10s. on 38,250 ordinary. £30,475 paid. £52,570 considered as paid on 2,750 preference and 100,000 ordinary. Mortgages and charges, £30,000.

English Electric Co., Ltd. (152,250).—Return dated May 30th, 1922. Capital, £5,000,000 in 1,500,000 preference and 3,500,000 ordinary shares of £1 each. 698,564 preference and 1,521,509 ordinary shares taken up. £315,673 paid. £1,904,400 considered as paid. Mortgages and charges, £2,190,100.

X-Rays, Ltd.—Deposit on August 23rd, 1922, of deeds of 10, Devonshire Grove, Old Kent Road, S.E., to secure all moneys due or to become due from the company to Lloyd's Bank not exceeding £10,000.

CITY NOTES.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.

Profit for the year ended December 31st, 1921, £6,078, as compared with £10,708 for the previous year. After providing for debenture interest and £5,500 for depreciation, there remains to be carried forward a balance of £3. Debentures amounting to £7,500 were paid off during the year, thus extinguishing the whole of the company's debenture debt. Having regard to the large sum which must be provided each year from revenue to meet depreciation on the company's plant and machinery, the board has had under careful consideration the future policy to be pursued in the best interests of both preference and ordinary shareholders. In the past the amounts placed to depreciation account have been utilised in redeeming the company's 7 per cent. debentures, provision for repayment of the outstanding balance of which was made in December last. It is now proposed to return to the preference shareholders their capital in the form of 6 per cent. non-cumulative income debenture stock, with capital and interest rights practically identical with those attaching to the preference shares, but subject to redemption, and to utilise the amounts to be provided for depreciation in discharge of this stock, which the company will be entitled to redeem by purchase or tender. With the cancellation of this stock the ordinary shareholders will gradually become entitled to the whole of the reversion of the company's assets.

Meetings called by order of the Court to approve the scheme will be held at Winchester House, Old Broad Street, on September 14th.

Tyneside Tramways & Tramroads Co.

The half-yearly meeting of the Tyneside Tramways & Tramroads Co. was held in Newcastle-on-Tyne on August 29th. Mr. G. E. Henderson, the chairman, in moving the adoption of the report, said that £2,639 had been spent from the reserve fund for the re-surfacing of the track on the North Road, in re-building rolling stock, and other work. The reserve fund now stood at £41,701, as against £38,397 last year. Without attempting to forecast the future, he mentioned that their financial position for the past few weeks was a little better than last year, and he believed that that improvement would continue. The report was adopted.

Nenagh Gas and Electricity Co., Ltd.

Capt. Poe, chairman, presided at a meeting of shareholders which considered a report from a committee appointed to investigate the company's affairs, which were declared to be in a serious condition. The committee attributed the difficulties to the flotation of the company at a time when money was at the height of inflation, lack of supervision by responsible officials, under-capitalisation, and uneconomic working; and recommended reductions in salary and wages lists, in price of gas and electricity, and with regard to £4,000 due under the head of trade creditors, the raising of further capital, or, alternatively, a further advance from the bank, or the issuing of short-dated debentures to principal creditors, dividend on preference shares to be withheld meantime. The report was adopted, and it was arranged that the shareholders should be circularised, so as to ascertain their views on future action.

South London Electric Supply Co., Ltd.—Dividend of 5 per cent. per annum, less tax, on odinary shares for the half-year.

Brazilian Traction, Light and Power Co., Ltd.—Quarterly dividend on cumulative preference shares of 1¼ per cent.

Crossley Brothers, Ltd.—The directors report they are not yet able to recommend the payment of the dividend on the preference shares due September 1st.

American Telephone and Telegraph Co.—Interim of 2¼ per cent. on capital stock.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 148A :—

Adelaide Electric Supply Co.—68,678 six and a-half per cent. "C" cumulative Preference shares of £1 each, partly and fully paid, witnin Nos. 1 to 68,678.

Dealings in the following have been specially allowed by the Committee under Rule 159 :—

Marconi's Wireless Telegraph.—20,000 ordinary shares of £1 each, fully paid, Nos. 2,933,259 to 2,953,258.

Northern Mexico Power and Development.—67,428 common shares of $100 each and 28,570 seven per cent. cumulative preference shares of $100 each.

The undermentioned have been ordered to be officially quoted :—

Marconi's Wireless Telegraph.—20,000 ordinary shares of £1 each, fully paid (Nos. 2,933,259 to 2,953,258).

Northampton Electric Light & Power Co., Ltd.—Interim dividend of 4 per cent., less tax, on "B" ordinary shares.

The Direct Spanish Telegraph Co., Ltd.—Dividend at the rate of 10 per cent. per annum on the preference shares; an interim dividend at the rate of 8 per cent. per annum, free of income tax, on the ordinary shares, both for the half-year ended June 30th last.

Western Telegraph Co., Ltd.—Dividend of 5s. per share, making a total of 10 per cent. for the year, ended June 30th, 1922, free of income tax.

Lancashire Dynamo & Motor Co., Ltd.—Interim dividend of 3 per cent. actual, tax free, on ordinary shares.

Clarke, Chapman & Co., Ltd.—Interim dividend of 1s. per share, less tax, on ordinary shares.

Oxford Electric Co., Ltd.—A dividend at the rate of 5 per cent. per annum, less tax, on ordinary shares is announced.

Canadian General Electric Co., Ltd.—Dividend of 1¼ per cent. for the three months ended September 30th on the common stock.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange conditions underwent a decided change for the better upon the passing of the September 1st settlement without any open trouble becoming manifest. This was the date fixed as being twelve months after the official termination of the war, and, in spite of the eight years which have passed since the outbreak of the struggle, there was still a certain remnant of stock unpaid for, and of bargains yet uncompleted, which gave rise to apprehensions, more especially as the uncertainties of foreign politics added anxiety to the position. Nevertheless, the settlement has been successfully surmounted, and Stock Exchange markets are once more upon an even keel as regards pre-war obligations. Money has begun to flow into securities, and, notwithstanding the breath of business which begins to give a welcome sign of rippling the currents of industry, the amount of capital required for business developments is not sufficient to make any difference to the demand for good-class stocks and shares. The electrical industry is in favour, and the declaration of an interim dividend of 5 per cent. on South London Electric Supply ordinary shares has served to raise the price by 7s. 6d.

The Home Railway market is giving a better account of itself. Districts in particular have recovered from some of the weakness which overtook them on account of liquidation of weak stock; and from 39 the price ran to 41¼. At the same time, Metropolitan consolidated, which had been down to 54, rallied to 55. The Underground group is quiet, without any particular feature, but attention has been directed again to the debenture stocks of the East London Railway which are indicated in various directions as holding opportunities for appreciation. It deserves to be noticed, however, that the dulness of preference stocks and (less noticeable) of debentures continues to be apparent, and prices in the pre-ordinary department of the Home Railway market show tendencies to dwindle. This is explained in part by reference to a possibility of the next change in the Bank Rate being in the upward direction.

Underground Electric income bonds are now quoted ex their dividend of £2 per cent. net.

Mexican Utilities are no better, but the news from the country is decidedly more encouraging than it has been for some time past. The Mexican Government has proposed a scheme of arrangement under which it should be possible for the payment of obligations to be, at any rate, commenced. In consequence, prices of Mexican Government bonds are 2 to 5 points higher, and unless the scheme is turned down, as seems unlikely to happen, there should be a general recovery in Mexican securities as a whole. Brazilian Tractions have risen to 52, a gain of 2¼, on the expectation that the quarterly dividend of 1 per cent. can be maintained, as to which a lurking doubt had begun to manifest itself owing to the drop in the Brazilian exchange. British Columbia Electric stocks are steady.

Babcock & Wilcox have recovered to £3. Other shares in the engineering group are inclined to hang fire, movements, however, being confined to very small alterations. English

Electric preference are firm at £1. Other shares in the manufacturing group are simply steady.

The rise in South London shares to 3⅞ has already been mentioned. New County of London ordinary, after dipping to 3s. 1½d. premium, recovered to 3s. 6d. premium, the preference holding their premium of 2s. 1½d. with noticeable strength. Chelsea ordinary are ¼ up at 6½. Metropolitans are equally better at 5¾, and City of London ordinary hardened to 22s. 6d.

Marconis are the only active shares in the telegraph and telephones group. The price rose to 2⅞, on active bidding for the shares this, Tuesday, afternoon. Radios, after a drop to 21s. 6d., recovered a shilling, and the preference at 14s. 3d. are slightly harder than they were. The Eastern cable issues are quiet, and no changes have occurred amongst the others in this market.

Rubber shares continue dormant, the low price of the material affording no cause for encouragement to the long-suffering clientèle who hold rubber shares.

British Electric Traction ordinary has gone back to 57. London Electric Railway 4½ per cent. debenture holds its price at 95¾; the City & South London twin stock is also quoted 95½-96. Of the other new issues, Bengal Telephone sevens are 100½, a premium of 3½, and the Madras Electric 7 per cent. second debentures are rather better at ¼ premium. It is stated in responsible quarters that certain electrical companies with debenture stocks that fall due for repayment within the next decade or so, are debating the question of antedating the redemption of the stocks. Holders of sound securities of this nature may be glad of a hint not to sell unless they require money now.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1920.	Dividend 1921.	Price Sept. 4. 1922.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	7⅞	—	£7 14 10
Charing Cross Ordinary	8	9	7⅝	—	5 17 0
do. do. 4½ Pref.	4½	4½	4	—	5 12 6
Chelsea	6	6	6½	+ ¼	4 16 0
City of London	14	14	21½	+ ⅛	6 11 9
do. do. 6 per cent. Pref.	6	6	29/-	—	5 4 4
County of London	8	8	1⅞	—	5 11 4
do. do. 6 per cent. Pref.	6	6	29/-	—	5 4 4
Kensington Ordinary	9	10	7⅜	—	6 15 7
London Electric	4½	4	2½	—	5 11 6
do. do. 6 per cent. Pref.	6	6	5	—	5 17 1
Metropolitan	7	7	8⅜	+ ⅛	6 1 9
do. 4½ per cent. Pref.	4½	4½	4	—	5 12 6
St. James' and Pall Mall	12	12	8⅜	—	6 17 2
South London	7	7	9¼	+ ⅜	7 4 4
South Metropolitan Pref.	7	7	1⅛	—	5 16 0
Westminster Ordinary	10	10	7⅞	—	6 9 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref	6	6	104½	—	5 14 8
do. Def.	1½	84/6	23½	—	7 9 0
Chile Telephone	6	6	6	—	5 0 0
Cuba Sub. Ord.	7	7	8½	—	8 9 8
Eastern Extension	10	10	18⅝	—	5 6 8
Eastern Tel. Ord.	10	10	186½	—	5 7 3
Globe Tel. and T. Ord.	10	10	19⅝	—	5 8 5
do. do. Pref.	6	6	11⅝	—	5 2 2
Great Northern Tel.	24	22	29½	—	7 10 6
Indo-European	10	10	86	—	5 19 0
Marconi	25	15	2⅞	+ ⅛	6 6 4
Oriental Telephone Ord.	12	12	2⅜	—	*5 1 1
United R. Plate Tel.	8	8	7	—	*5 14 4
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	19	—	*5 5 2
Home Rails.					
Central London Ord. Assented	4	4	87	—	5 19 5
Metropolitan	1½	2½	55	+1	4 2 0
do. District	Nil	1	41½	+ ½	2 5 2
Underground Electric Ordinary	Nil	Nil	9⅞	—	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	2	4	89½xd	—	*4 17 0
Foreign Trams, &c.					
Anglo-Arg. Trams. First Pref.	5½	12½	8½	—	7 17 2
do. do. 2nd Pref.	Nil	5½	5½	—	7 0 9
do. do. 5 per cent. Deb.	5	5	82	—	6 2 0
Brazil Tractions	Nil	Nil	52	+2½	7 18 10
British Columbia Elec. Rly. Pcs.	5	5	76½	—	6 9 9
do. do. Preferred	5	93/-	69½	—	*6 13 6
do. do. Deferred	8	124/-	78½	—	*8 2 4
do. do. Deb.	4½	4½	76	—	5 11 0
Mexico Trams. 5 per cent. Bonds	Nil	Nil	70¼xd	—	7 1 10
do. do. 6 per cent. Bonds	Nil	Nil	41½	—4	Nil
Mexican Light Common	Nil	Nil	20⅜	—	Nil
do. Pref.	Nil	Nil	4⅜	—	Nil
do. 1st Bonds	Nil	5	68½	—1	7 15 0
Manufacturing Companies					
Babcock & Wilcox	15	16	3	+ ⅛	5 6 8
British Aluminium Ord.	10	10	18/8	—	—
British Insulated Ord.	15	15	42/-	—	7 2 10
Callenders	15	15	2⅛	—	7 1 2
6½ Pref.	6½	6½	1⅛	—	5 15 7
Crompton Ord.	10	5	15/-	—	6 18 4
Edison-Swan	10	Nil	2/3	—	Nil
do. do. 5 per cent. Deb.	5	5	64	—	7 16 4
Electric Construction	10	10	1¼	—	8 0 0
English Electric	8	5	17/6	—	5 14 3
do. do. Pref.	6	6	1	+ 1/32	6 0 0
Gen. Elec. Pref.	6½	6½	22/-	—	5 18 2
do. Ord.	10	5	18/9	—	5 6 8
Henley	15	15	2½	—	6 18 4
do. 4½ Pref.	4½	4½	4⅜	—	5 2 10
India-Rubber	10	—	⅝	—	—
Met.-Vickers Pref.	8	8	2½	—	a 8
Siemens Ord.	10	10	27/6	—	*7 5
Telegraph Con	20	20	95	—	*4 12 2

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, September 6th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic ... per lb.	7½d.	...
a Ammoniac, Sal ... per ton	£63	...
a Ammonia, Muriate (large crystal) ,,	£48	...
a Bisulphide of Carbon ... ,,	...	...
a Borax ... ,,	£30	...
a Copper Sulphate ... ,,	£26 10s.	...
a Potash, Chlorate ... per lb.	5d. to 5½d.	...
a ,, Perchlorate ... ,,	7⅞d.	...
a Shellac ... per cwt.	£16	15s. dec.
a Sulphur, Sublimed Flowers ,,	£11 10s.	...
a ,, Lump ... ,,	£11	...
a Soda, Chlorate ... per lb.	2½d.	...
a ,, Crystals ... per ton	£6	...
a Sodium Bichromate, casks ... per lb.	5d.	...
METALS, &c.		
b Aluminium, Ingots ... per ton	£100	...
b ,, Wire ... per lb.	1/9 to 2/6	...
b ,, Sheet ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... per ton net	£150	...
Grade II ... ,, ,,	£108	...
Grade III ... ,, ,,	£62	...
c Brass (rolled metal 2" to 12" basis) per lb.	9½d.	...
c ,, Tubes (solid drawn) ,,	11¾d. to 1/-	...
c ,, Wire, basis ... ,,	9½d.	½d. dec.
c Copper Tubes (solid drawn) ,,	1/1½	...
c ,, Bars (best selected) ... per ton	£94	...
c ,, Sheet ... ,,	£94	...
c ,, Rod ... ,,	£94	...
d ,, (Electrolytic) Bars ,,	£71	...
d ,, ,, Sheets ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£81	...
d ,, ,, H.C. Wire per lb.	10¾d.	...
f Ebonite Rod ... ,,	3/6	...
f ,, Sheet ... ,,	3/-	...
n German Silver Wire ,,	2/6	...
h Gutta-percha, fine ... ,,	12/6	...
h India-rubber, Para fine ... ,,	10½d.	...
l Iron Pig (Cleveland Warrants) ... per ton	90/-	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£94	...
g Lead, English Pig ... ,,	£25 10s.	10s. dec.
g Mercury ... per bot.	£12 10s. to £12 15s.	15s. to £1 inc.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/1	...
p ,, drawn bars and rods ,,	1/3	...
p ,, rolled strip & sheet ,,	1/2½	...
p ,, wire ... ,,	1/3½	...
o Platinum ... per oz.	£19 10s.	...
d Silicium Bronze Wire ... per lb.	1/1	...
r Steel, Magnet, in bars ... ,,	1/-	...
n Tin, Block (English) ... per ton	£159 5/- to £159 10/-	5s. to 10s. dec.
n ,, Wire, Nos. 1 to 16 ... per lb.	8/-	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Deep X-ray Therapy.—Although King's College Hospital was built and supplied less than ten years ago with the latest equipment for hospital work, the progress of research in connection with X-rays and radium has been rapid under the direction of Dr. Robert Knox, and a further development is about to be made by the use of one of the seven empty wards of the hospital for deep therapy work. Apparatus equal to that in use in Erlangen is being supplied by Messrs. Watson & Sons to Dr. Knox's specification, and will be tested by the National Physical Laboratory. Arrangements have been made for the cost, amounting to £1,500, to be advanced by a generous supporter of the hospital, though it is hoped that contributions will be forthcoming from those who appreciate the importance of any endeavour to mitigate the suffering from cancer and allied disease.—*Daily Telegraph.*

An Improved Telephone.—It has occurred to a German electrical engineer, Dr. Georg Seibt, of Berlin-Schöneberg, that the efficiency of the telephone could be increased considerably by improving the electro-magnet on the attraction of which the vibrations of the diaphragm are dependent. Dr. Seibt's improved telephone comprises laminated, in the place of solid magnet cores, which, while not interfering with magnetic effects, counteract eddy-currents. The cores have been given a closer form, thus reducing the resistance to the magnetic lines of force and increasing the intensity of magnetisation. It has thus been possible to raise the acoustic efficiency of the telephone to double or two and a-half times the figure otherwise attainable.—*Manchester Guardian Commercial.*

THE SAYERS DYNAMO.

A New Design.

By W. BROOKS SAYERS.

Some time ago it was announced* that a new design of electric generator and motor had been evolved which, it was claimed, would appreciably reduce the cost of building such machines and at the same time make it possible to manufacture a machine which, for a given weight and size, would produce a considerably greater output than that of the standard type. Such claims naturally excited considerable interest, but for certain good reasons very few details could be made public at the time.

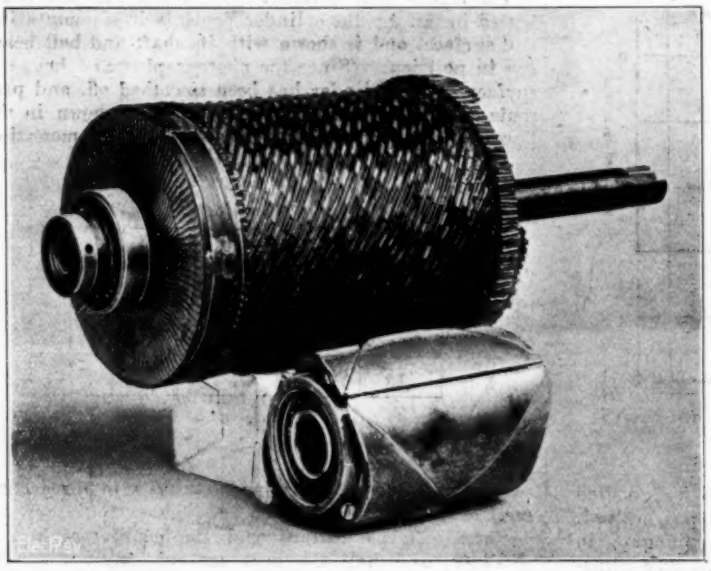

Fig. 1.—Sayers Helical Induction Cylinder and Free Core.

During the intervening 10 months, however, matters have progressed somewhat, as is shown by a recent report on the invention, in the course of which Mr. James Swinburne, F.R.S., a consulting engineer who needs no introduction, says:—"I consider that you are on a new, and almost unexplored, path in dynamo design; and that the adoption of your type of armature will increase the ratio of output to price in most cases; and that it will also increase the efficiency and the ratio of output to weight. . . . The general basis on which you are working is quite new to me, and I am an old dynamo designer. . . . I think you have a very good thing. . . ."

The dynamo-electric machine in all forms depends for its essential action on the cutting of magnetic lines of force by revolving conductors. For this purpose re-entrant windings of one form or another are employed. Such windings hitherto have consisted of wires, or conductors, laid in slots approximately parallel with the axis of the shaft and formed into a re-entrant winding by means of end connecting-wires, or bars, which occupy valuable space and cause a material part of the electrical resistance and heating of the armature.

The Sayers helical re-entrant inductor cylinder forms, it is claimed, an incomparably better basis for dynamo-electric machinery of all types and sizes than the forms of re-entrant winding in or upon laminated iron cores hitherto known. The helical bars associated with the necessary iron strip or wire to carry the transverse magnetic induction build into an independent cylindrical structure without added length for end connections, are ideal from the electrical standpoint of efficiency, and have excellent mechanical properties of robustness and stability. Moreover, the conditions for sparkless commutation with or without commutating poles are vastly improved.

The development of electric power and lighting schemes has been enormous during the past 15 or 20 years, but no radical advance has been made during this period in efficiency, weight, and output of generating machines and motors for a given price. The Sayers invention is a radical advance, passing the barrier which expert designers know as "space factor" and eliminating the necessity for expensive material and wasteful methods at present in vogue (laminated highest-quality iron of which 50 per cent. is wasted in scrap, and varnished tapes and other combustible insulating material).

The present method of embedding conductors in slots in laminated-iron structures and providing ventilating ducts for carrying off the heat generated involves losses on an increasing scale. A compact structure with eddy currents and hysteresis minimised would give the highest efficiency, but the heat unavoidably generated even with very thin laminations must be got rid of. To effect this, ventilating ducts are essential; the ducts and their associated fan or impellers involve windage losses themselves and also increased dimensions of the whole structure, which involve greater lengths and resistances and consequently *more heat to be got rid of*. Temperature rise is the controlling factor, and designers therefore find limits to output per unit weight, efficiency and price.

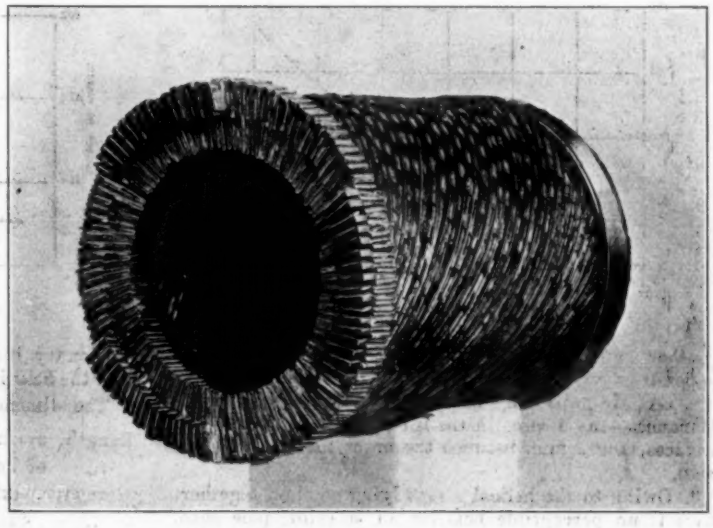

Fig 2.—Helical Induction Cylinder.

The new Sayers cylinder is (to begin with) of abso-

* Elec. Rev., November 4th, 1921, p. 590.

lutely minimum weight and resistance for a given duty; it is thought to be amply and abundantly ventilated without appreciable spreading for air ducts, and it enables a *solid stationary core* to be used, which is vastly cheaper to manufacture and lighter and better in every way than a laminated core; moreover, it entirely avoids the generation of heat in its mass by eddy currents and hysteresis.

The desirability of a free core has been recognised

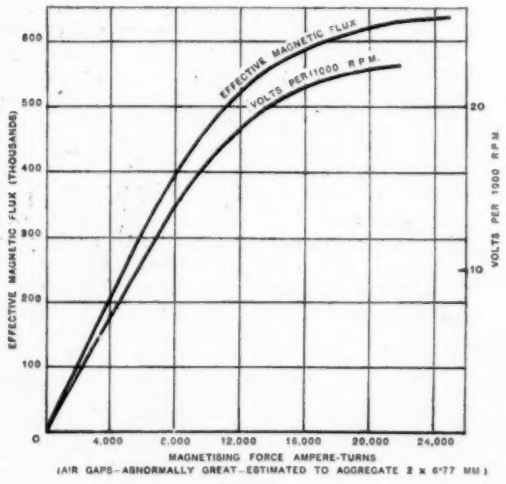
EFFECTIVE MAGNETIC FLUX
VOLTS PER 1000 R.P.M.
EFFECTIVE MAGNETIC FLUX (THOUSANDS)
VOLTS PER 1000 R.P.M.
MAGNETISING FORCE AMPERE-TURNS
(AIR GAPS-ABNORMALLY GREAT-ESTIMATED TO AGGREGATE 2 x 6·77 MM.)

Fig. 3.

by several previous inventors, but no practical method of employing a freely-mounted solid core was evolved. The free-core arrangement involves three air gaps in place of one, with a slot-wound laminated core armature. This, at first sight, might appear to off-set to some extent the advantages by increased excitation expenditure, but this apparent disadvantage is transformed into a further advantage on investigation, because:

1. The effective area of the air gaps is from 50 to 100 per cent. greater than that given by the aggregate of the teeth, plus fringe allowance, in a toothed armature.

2. The edges of the helical iron strip may be so close

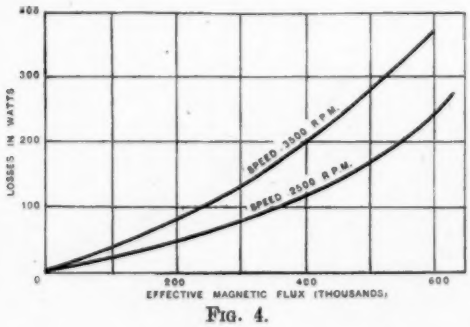

Fig. 4.

together and form so true a cylindrical surface (depending on the degree of excellence of manufacture) that the air gaps may be reduced to safe mechanical clearances—say 1 mm. in the internal and intermediate surfaces, and 2 mm. between the outer surface and pole faces.

3. Owing to the helical strips lying so close together, there is no perceptible heating of a solid pole shoe, which may continue practically to a sharp edge *without causing noise*.

4. Again, owing to the same cause, there need be no "tooth ripple" and no disturbance to telephone or telegraph systems due to inductance.

5. When adopted on a.c. generators, a smooth sine wave will be produced.

6. Owing to the iron being disposed between the conductors instead of forming an iron circuit round them in groups, and also to the iron being discontinuous, the self-induction of the armature sections is greatly diminished, even with the shortest possible air gap, and good commutation is correspondingly facilitated.

The claims put forward, therefore, are well founded. The invention is amply covered by patent rights already granted and by others for details pending. The preliminary work has already been done, and working examples are to be seen by appointment at Faraday House, Southampton Row, London, where several have been built, the one referred to below having been completed in July last.

The helical strip cylinder and its free core are illustrated in fig. 1; the cylinder presents its commutating end surface, and is shown with its shaft and ball bearing in position. (Since the photograph was taken, the surface of the cylinder has been smoothed off, and presents a more regular appearance than is shown in the figure.) At the commutator end the shaft mounting

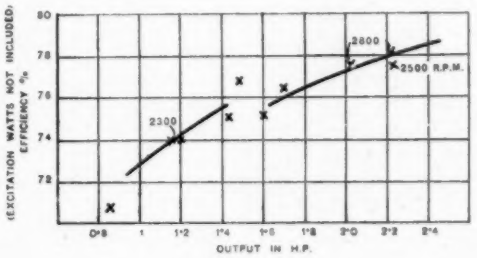

Fig. 5.

carries mica-capped dogs, which engage in three large recesses formed in the back of the commutator connectors. At the distant end the connectors form a shoulder, and half the bars are cut longer than the others in three groups, fig. 2; by means of mica-capped drivers a thoroughly mechanical fixture is secured for receiving or transmitting torque and resisting tension due to the centrifugal force on the bars.

The "free core" is divided longitudinally, thus providing for air ingress, the surface being also recessed lozenge-shape as required for most effective operation; there is free ventilation inside, a minimum of cross magnetisation, and advantageous commutation conditions. It is mounted on ball bearings and remains

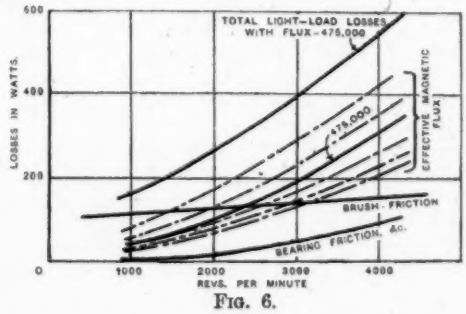

Fig. 6.

stationary inside the cylinder when the latter revolves and the field is excited.

The dimensions of the cylinder are as follows:—

Length, overall with end mounting ...	7½ in.
,, of helix	5½ in.
Diameter, external	5 3/32 in.
,, internal	3½ in.
Mean angle of helical bars with axis ...	45 deg.
Weight, with commutator	13 lb. 11 oz.

The number of composite helical bars is 216, *i.e.*, 108 each in the inner and outer layers. The bar spans are substantially 180 deg., giving a two-pole re-entrant winding, and each bar is composed of a copper and an iron strip laid together in contact, alternate bars only being wound with asbestos strip 1/64 in. thick and

$\frac{1}{4}$ in. wide, the laps being spaced $\frac{1}{4}$ in. apart to allow space for the passage of air between each conductor. The dimensions of the bars are:

Copper, 0.375 x 0.022 in.
Iron, 0.375 x 0.02 in.
Asbestos strip (varnished), 0.0156 in. thick.

The electrical resistance of the armature between the brushes is 0.05 ohm.

The composite helical bars are channelled in such a manner that their projected tangential thickness with insulation is at all diameters equal to the pitch of the conductors.

The cylinder is mounted at the commutator end upon a simple expanding device, and is positively driven through mica insulation by three dogs which fit into recesses formed in the inner end-connectors, the outer surface of which forms the commutator surface. At the opposite end a gunmetal carrier engages the castellated end of the cylinder and fits upon the splined shaft. Jack screws bearing on a fixed abutment in the shaft take the tension of the conductors.

The accompanying curves show the performance of the machine. These results are given with the *distinct reservation* that, while they indicate to the designer that the structure functions in practice normally, they are far below what is demonstrably realisable with the helical inductor cylinder. With regard to fig 5, the low temperature rise, 37° F. after one hour's run at 2,500 r.p.m., while producing an output of $1\frac{3}{4}$ b.h.p., shows that the ventilating arrangements are much more effective than the ventilating ducts generally employed in slot-wound laminated-core armatures. The brush gear functioned absolutely sparklessly at all loads without needing any adjustments, but a greater load than that indicated was not available at the time the test was made.

The tests recorded above were made on a d.c. machine, but the induction cylinder is equally applicable to a.c. machines.

IONIC CURRENTS.

In a note presented to the French Academy of Sciences on July 10th, M. Maurice Leblanc dealt with the properties of three-electrode valves filled with gas at low pressure. The note was reproduced in *La Revue Générale de l'Electricité* of August 19th, from which source we derive the following particulars:—

In the gas-filled three-electrode valve, the space between the anode and the cathode does not acquire a "space charge"; a potential difference of a dozen volts will cause hundreds of amperes to flow, but the properties of such valves differ from those in which the current is carried by electrons, and they must be used in a different way.

Fig. 1 shows a three-electrode valve filled with mercury vapour; it consists of a glass bulb carefully exhausted of air, and containing an iron or carbon anode *a*, a metal grid *b*, and a mercury cathode *c*. An auxiliary anode *d* enables an arc to be maintained between it and the cathode, in order to keep the valve continually "primed."

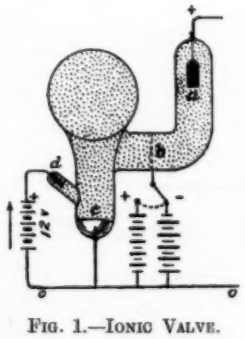

Fig. 1.—Ionic Valve.

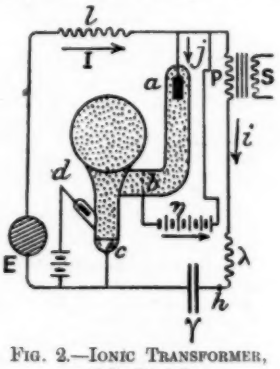

Fig. 2.—Ionic Transformer, d.c. to a.c.

Current can only traverse the bulb from the anode *a* to the cathode *c*. If the grid is made negative with regard to the cathode whilst a current is flowing, the grid is covered with a layer of positive ions, which neutralise its charge, and the current is not interrupted as it would be in the case of an electronic valve. But if by acting on the external circuit the current is interrupted, for a period which may be very brief, the grid being negative reabsorbs the positive ions deposited on it and afterwards prevents the emission of electrons by the cathode as in the electronic valve. The current cannot be re-established while the grid remains negative; for that purpose, its charge must be made zero or positive.

These properties can be utilised as follows:—

1. *Transformation of direct current into alternating current of high frequency.*—A circuit (fig. 2) comprises a source of constant e.m.f. E; an inductance coil *l* resisting any appreciable variation of the strength of the current I in the circuit for the duration of one cycle of the alternating current that is to be generated; the primary winding P of a transformer, of which the secondary winding S is connected to the consuming circuit; and a resonator consisting of an inductance λ and a capacity γ. Between the points indicated is connected one of the primed ionic bulbs described above of which the grid is connected to the anode *a* by a circuit containing an e.m.f. η.

Assume the cathode *c* to be at zero potential, and let *h* be the potential at the other terminal of the condenser, *i* the current in the coil λ, and *j* the current flowing through the bulb (the current flowing to the grid will be negligible). Now, if, when the device is in operation, the current *j* dies out, the grid is then negative, the current through the bulb cannot be restarted, and the current I will charge the condenser. But directly *h* equals η, the grid ceases to be negative and the bulb short-circuits the resonator, the discharge current in which oscillates, whilst dying away, with a frequency α differing but little from $1/2\pi\sqrt{\lambda\gamma}$. If the energy $\frac{1}{2}\gamma\eta^2$ is greater than EI/α, the current *i* becomes equal to I; the current *j* becomes zero, the grid is then negative and remains so until the potential *h* is again equal to η, and so on.

Thus continuous waves are produced, the current *i* and the potential *h* varying as shown by the curves in fig. 3. The positive waves are truncated, but they are the less deformed

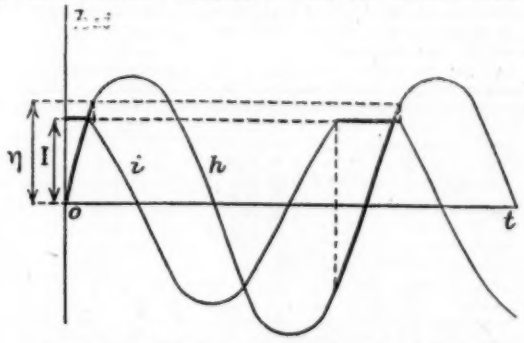

Fig 3.—Wave-form of High-frequency Current.

in proportion as the quantity of energy $\frac{1}{2}\lambda I^2$ is greater compared with $\frac{1}{2}\gamma\eta^2$; if the latter is small with respect to the former, the pressure at the terminals of the consuming circuit is constant.

If, for example, E=500 V, I=20 A, α=20,000, we must make $\gamma\eta^2$=1 joule, and in order that the waves may not be much deformed, make λI^2=4 joules. Then we shall have λ=0.01 henry, γ=0.00633 microfarad, and η=12,566 volts.

Lest this pressure should set up an arc between the anode *a* and the grid, the grid circuit must have a high resistance; but if it were too high, the grid would not be able to absorb almost instantaneously the positive ions with which it was covered at the moment when the current *j* fell to zero, as well as the ions still liberated in its neighbourhood by molecular agitation or by the ultraviolet rays emitted by the cathode. All difficulty can be avoided by cooling the grid with a current of oil or water, which will permit the resistance in its circuit to be reduced without allowing it, by heating, to become a cathode. Fig 4 shows how this can be done.

This method of transformation must have a very high efficiency; the bulb behaves as though it were a valve always fully open or completely closed. On the other hand, the heterodyne bulb behaves like a valve always throttled, whose aperture is periodically varied, and its efficiency is at most 45 per cent. The author has not as yet carried out this method of producing currents of high frequency, but has explained the principle because it can be combined with the method next to be described (which has already been realised) to form a new system of electric traction.

3. *Transformation of alternating currents of high frequency into currents of normal frequency, variable at pleasure.*—The apparatus employed is shown in fig. 5. It comprises: a transformer A, whose primary winding P is fed with the current to be transformed. The two secondary circuits, s_1 and s_2, are identical but differently connected, the start of the first and the finish of the second being joined to a neutral point O; four bulbs 1, 2, 3, 4, like that already described. The anode of bulb 1 and the cathode of bulb 4 are connected to the finish of the winding s_1, the anode of bulb 2 and the cathode of bulb 3 are joined to the start of the winding s_2. Finally, the cathodes of bulbs 1 and 2 and the anodes of bulbs 3 and 4 connect with a conductor XX, and the consuming circuit R is joined between this conductor and the neutral point.

To charge the grids a small transformer B is used, of which the primary circuit p_1 is fed by a battery Ac, the polarity being periodically reversed by a commutator c; the frequency of the current obtained is equal to the speed of rotation of this commutator. The transformer B has three secondary windings, $s_{1,2}$, s_3, and s_4; the first is joined between the grids

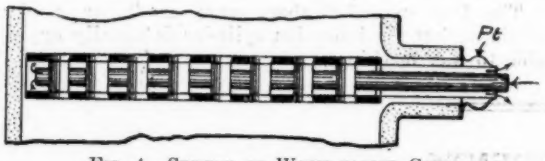

Fig. 4.—Section of Water-cooled Grid.

Pt, flexible collar of platinum, welded to the glass and to the outer tube.

of bulbs 1 and 2, joined in parallel, and the conductor XX, making them simultaneously positive or negative with regard to their cathodes. Winding s_3 is connected between the grid and the cathode of bulb 3, and winding s_4, between those of bulb 4. [Here the text and the figure are not in agreement. —Eds.] The connections are so disposed that the grids of bulbs 1 and 2 are positive when those of bulbs 3 and 4 are negative, and *vice versa*.

Let us suppose the grids of bulbs 1 and 2 to be positive at the instant when the circuit R is closed; a current can then flow through it only in the sense of the arrow, fig. 5. The circuit will be completed through either bulb 1 and winding s_1, or bulb 2 and winding s_2.

If the circuit R has no self-induction, the current will vary in the circuits s_1, s_2, and R as shown on the left of fig. 6; if it is inductive, the current will grow gradually, as shown on the right of the figure.

Let us now make the grids of bulbs 1 and 2 negative, and those of bulbs 3 and 4 positive. If the circuit R is inductive, the current which traverses it cannot immediately change sign

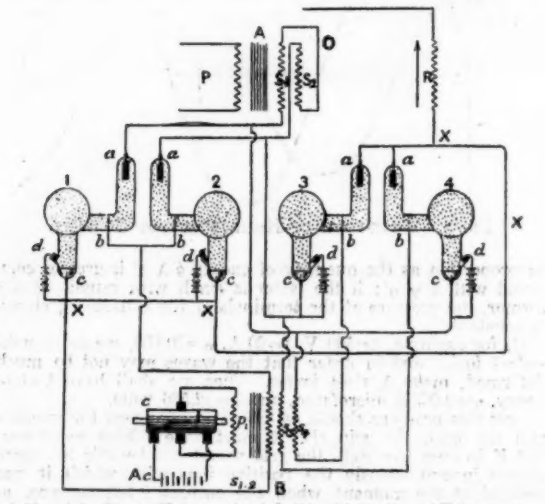

Fig. 5.—Ionic Transformer, High to Low Frequency.

in passing through zero, and until it does so, it cannot traverse bulbs 3 and 4, not being able to go from their cathodes to their anodes.

At the moment of commutation it was traversing, for example, bulb 2. It cannot re-establish itself in bulb 1, the grid of which has been made negative while no current passed. It continues, therefore, to pass through bulb 2 and winding s_2. But the alternating e.m.f. developed in this circuit cannot sustain it. It dies away and, after being annulled, re-establishes itself through bulbs 3 and 4, traversing the circuit R in the opposite sense to the arrow.

The oscillogram, fig. 7, taken during the transformation of a current of 500 cycles frequency to 50 cycles, with a circuit R possessing resistance and inductance, shows that this is indeed the case.

Now, if the current continues to pass in bulb 2, whilst the grids of bulbs 3 and 4 have become positive, a short circuit current is set up through bulbs 2 and 4 and the circuits s_1 and s_2, every time the e.m.f.'s developed in the latter tend to

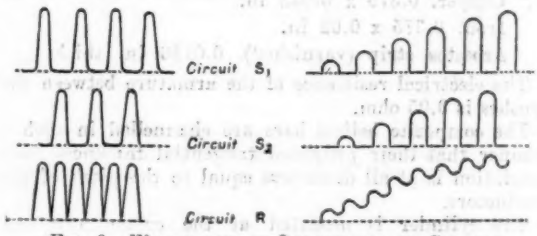

Fig. 6.—Wave-forms of Low-frequency Current.
Without inductance. With inductance.

make the current enter by the anode of bulb 2 and leave by the cathode of bulb 4, say for half the time. To avoid this, it is necessary that the segment of the commutator c which is connected to the negative pole of the battery Ac shall subtend a greater angle than the one connected to the positive pole, so that the current passing through bulb 2 may die out between the moment when the grid of this bulb ceases to be positive and that when the grids of bulbs 3 and 4 begin to be positive; by means of this precaution a very high efficiency is obtained.

Other experiments have shown that one could likewise, by rendering the grid of a bulb successively positive and negative, deal with alternating currents of a frequency of 30,000 cycles per second.

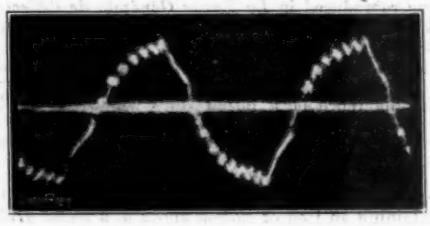

Fig. 7.—Oscillogram of Low-frequency Current.

Finally, by arranging several similar apparatus fed by other secondary windings S_1', S_2', S_1'', S_2'' . . . , excited by the same primary circuit P and with the commutators mounted on one shaft, but successively displaced with regard to one another, one could produce currents out of phase with one another.

In a later issue we shall show how the author proposes to apply the system to the electrification of railways.

The Diesel Engine in Electric Furnace Work.—The Diesel engine has been used in various industries, but as the source of power for electric furnaces the oil engine has not received the attention it deserves, says *Power*. The general opinion has been that an oil engine of a capacity suited to the normal working demand of an electric furnace has insufficient reserve capacity to cope with the furnace starting load. That this is not correct is proved by the results of the Diesel-engine power plant of the Oklahoma Iron Works Co., Tulsa, Okla. The power plant contains four Nordberg two-stroke Diesel engines, one of which, of 750 h.p. rate, is direct-connected to a two-stage 4,000-cu. ft. compressor supplying air to drive the hammers in the forge shop and other air-driven machines in different departments.

Three 550-h.p. units are direct connected to 400-kVA alternators and are provided with belted exciters. The total connected electrical load is 1,535 kW; 1,100 of this is composed of induction motors, 35 kW is used for lighting and 400 kW in the electric furnaces. Fifty per cent. of the motors are squirrel-cage and the remainder are slip-ring type machines. The usual motor load ranges from 75 to 350 kW, with a daily average of 250 kW. The furnace load ranges from 150 to 600 kW and is very unsteady during the first part of a heat. The following are the production costs per kilowatt-hour when operating under the conditions stated:—

Fuel oil, cents	0.397
Lubricating oil, cents	0.048
Labour, cents	0.329
Repairs, cents	0.004
Total production cost per kWh, cents	0.778

The total cost per kilowatt-hour including fixed charges is less than two cents. Fuel oil of 25 deg. Baumé is burned, and the engines have operated satisfactorily either singly or in parallel. The lubrication consumption averages 0.2 gallon per hour per unit, there being little change in the rate from light to heavy load.

THE TELETYPE.

A New Printing Telegraph.

During the past few years remarkable developments have taken place in telegraph and telephone mechanisms, but it is only since the completion of the development of the multiplex system that machine telegraphy has really begun to come into its own. The multiplex printing telegraph, however, is only suitable for heavy traffic between busy centres; it is quite unsuitable for the immense number of minor telegraph lines that form the bulk of the telegraph network of all countries and entirely unsuited for use outside of the telegraph network, for instance, as a means of intercommunication in big manufacturing plant, hotels, banks, newspaper offices, and big institutions of all kinds. Up to the present, business men have had to rely on the inaccurate telephone and the slow post.

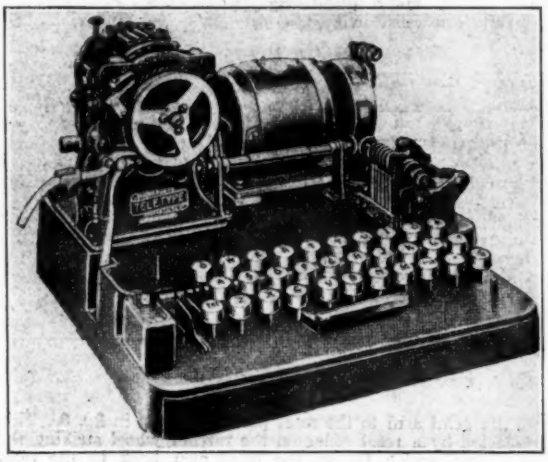

Fig. 1.—Transmitting-Receiving Teletype.

The new development of machine telegraphy, originating in Chicago and known as the "Teletype," to which brief reference was made in our columns a few weeks ago, is therefore of considerable theoretical as well as practical interest. It does for minor telegraph lines and for the internal economy of business and industry what the multiplex printing telegraph is doing for the long and heavily-loaded telegraph lines between large centres of population.

The teletype, made by the Morkrum Co., of Chicago, has now been in use for about a year in the United States, and has already established itself in Europe as a successful and indispensable telegraph machine. The British Post Office has bought four teletypes, and the secretary of the Post Office states that they "continue to give every satisfaction."

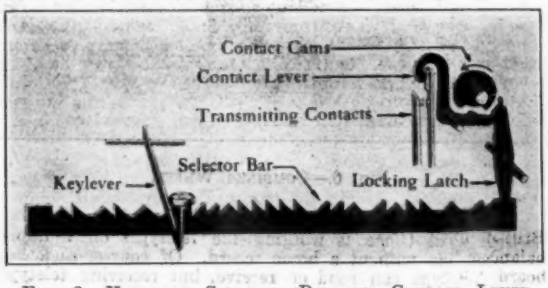

Fig. 2.—Keyboard Selector Bar and Contact Lever.

The Midland Railway Co., the pioneer in the use of the teletype in Europe, has two machines working on a line between Derby and Birmingham, with very satisfactory results. The Marconi Co. has gradually increased its stock of teletypes until it has now 16 in use in London connecting local offices and large customers to Radio House. The Dutch Government bought 12 and will soon have 30 in service. The Indian Government has ordered four, the Straits Settlement authorities two, the Siamese Government four (for the Bangkok-Singora line, 600 miles of iron wire) and the Gold Coast authorities three. The Russian Government proposes to try the teletype, and there are numerous other interesting developments, including its use for wireless communication. The American naval authorities put a teletype on an aeroplane and communicated by wireless with the base station.

That the teletype can be used for wireless communication is a fact, though how far any printing telegraph can achieve commercial success in face of "static" or "atmospheric disturbances is a question not yet settled. There is promise in wireless printing telegraphy, but about the secrecy of communication by the teletype by wireless there is no question at all. Secrecy can be made practically absolute by quite simple means.

The teletype employs the five-unit alphabet prefixed with a starting and stopping unit signal. The prefix signal contact is normally closed so that the teletype is usually arranged to operate on the closed-circuit plan. The mechanism starts operation by the breaking of the closed circuit, and the machine is stopped by the closing of the circuit again. It is, therefore, strictly speaking, a seven-unit system compared with the eight-unit Morse system, and has a slight advantage over Morse apparatus, but the advantage is not nearly so great as in the case of the five-unit multiplex system. On the other hand, the speed of operation being only from 40 to 50 words per minute, the operating margin on nearly all telegraph lines is so great that the question of the limiting speed of the telegraph line seldom arises.

Referring to fig. 1, the teletype will be seen to consist essentially of a typewriter keyboard in front, a small transmitting mechanism on the right, a motor, a centrifugal flywheel governor to keep the motor speed reasonably uniform, and a printer at the back on the left, in front of which can be seen the three-spoke typewheel and the paper tape on which the message is printed. The printer is essentially a Baudot device combined with a mechanical distributor, which bears a close resemblance to the Hughes "chariot."

Fig. 2 shows one of the five selector bars, or code-bars, which lie side by side under the keyboard. Depression of any key lever moves one or more of these selector bars to the right or left, as the result of the pressure of the key lever on the wedge-shaped notches. Each selector bar controls one of five locking latches; the latter hold back or release one or more of five contact levers. Normally the contact levers hold the transmitting contact open. A group of five contact cams arranged spirally on a single-revolution cam spindle, as they revolve, permit the transmitting contacts to close and open again successively like playing successive notes on a piano; but any contact lever which is held back by a locking latch will prevent a contact closing.

Fig. 3 shows the complete transmitter unit and the parts will be recognised from the above description. There is, in addition, a locking loop which drops down at the right moment and prevents the next key from being depressed until the previous key signal has been transmitted. The teletype is arranged so that the normal speed is 40 words a minute (240 letters), but the machine will work at any speed from 10 to 50 words a minute; 45 words a minute, however, is about the limit for practical working.

The motor runs continuously, and when a key is depressed a clutch engages with a spindle driven by the motor and the transmitter cam-shaft makes a single revolution, thereby transmitting a letter signal; the clutch is then thrown out, and the cam shaft stops ready for the next letter.

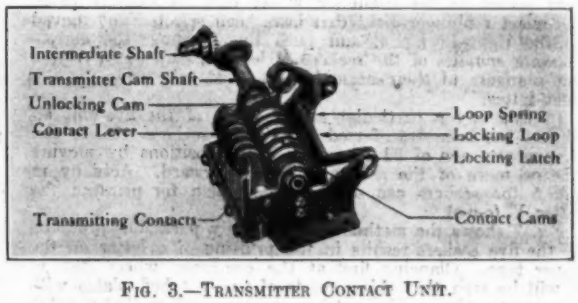

Fig. 3.—Transmitter Contact Unit.

The remaining feature, the printing mechanism, is difficult to describe in a simple way. Referring to fig. 4, the main shaft of the printer, driven by the motor by a gear-wheel, carries a shuttle keyed to the shaft so as to have a lengthways motion on the shaft, but it is carried round positively by the shaft. The small illustration to the right, fig. 4, shows the details of the shuttle. The shuttle spring tends to push the shuttle to the left. The shuttle carries a

roller and also a raised ring. Referring to the larger illustration, fig. 4, the printer has no electrical contacts; it is purely mechanical in its operation, and there is only one magnet consisting of a pair of coils that correspond exactly to the sounder of a Morse circuit. The signals from the telegraph line pass through these coils and attract or release the armature of the magnet. The armature therefore rises and falls under the control of the signal impulses and an armature extension, when the armature rises, also rises to the left of the raised ring on the shuttle and prevents the shuttle moving to the left. If the armature is attracted downwards, the shuttle is free to move to the left.

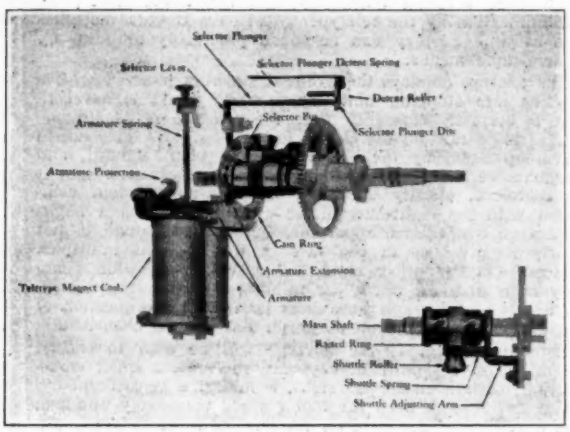

Fig. 4.—Received Signals Controlling Setting of Seekers.

Normally the shuttle roller presses against a steel cam ring having five notches in it arranged at intervals round the ring. In each notch there is a selector pin. If a line signal pulls down the magnet armature, then the shuttle armature will be free to move to the left under the pressure of the shuttle spring and the roller will enter a notch and press its selector pin sharply to the left. This pin will then oscillate a selector lever, which will in turn press a selector plunger to the right, where it will be caught by its detent roller. In the illustration it is shown in the left or unpushed position. There are five of these selector pins, levers, and plungers, and as the main shaft of the printer revolves the shuttle, co-operating with the armature of the magnet, will move one or more of the five plungers to the right. The five-unit signal is thus recorded in the relative positions of the five selector plungers.

Fig. 5 is a plan view of the five selector levers, plungers, and selector-plunger disks. It also shows a group of five seekers which are moved backward or forward (to or from the reader) in accordance with the particular selector plungers that were moved to the right in fig. 4 as already described. (To the reader in fig. 5.) This movement of the seekers is performed by the Baudot combiner wheel shown in fig. 6, projecting from the back of which will be seen two cam plates marked "setting face" and "resetting face." They will be recognised in fig. 5, and it is these cam plates on the combiner wheel that successively catch the selector plunger disks that have been selected and moved to the right in fig. 4, and push them against the corresponding spindles of the seekers. The cam plates also restore the plungers to their normal position of rest ready for the next letter.

In this way a particular signal group of the five-unit alphabet has been transferred to the five seekers. These can occupy any one of 32 permutations of positions by moving one or more of the seekers back or forward. Actually in fig. 5 the seekers are set in the position for printing the letter Y (o-o-o).

Fig. 7 shows the method by which any particular grouping of the five seekers results in the printing of a letter on the paper tape. Glancing first at the combiner wheel (fig. 6) it will be seen that this consists of two notched plates with a separator plate. The notches are arranged so that a notch on the edge of one plate always comes opposite a blank or continuous portion of the other plate. Turning again to fig. 7, it will be seen that each of the five seekers has a toe, which runs on one of the combiner wheel plates. Accordingly, as the seekers are shifted back or forward the toes will ride or run on the back or front combiner plate. The notches in the latter are so cut that for any particular arrangement of the seekers there is a particular place on the combiner wheel where each of the five toes will be able to drop down into a notch.

Normally, the seekers, not being able to tip forward on account of one or more of their toes not being over a notch, hold back the seeker trip lever. If the seekers all tip forward into notches in the edges of the combiner wheel plates, then the seeker trip lever will no longer be supported by the seekers and it will move forward under the tension of the trip lever spring, and the horizontal extension will strike the upper part of the trip pawl which retains the print arm mechanism in its place. The trip pawl being struck, the print arm will be liberated and it will rise under the tension of its spring and cause the print roll to press the paper tape against the revolving typewheel, thus printing a character on the tape, as shown in fig. 8. The ratchet wheel guides and controls this printing action, which also serves to feed the paper tape forward to the position for printing the next letter. The remaining operation is to restore the print arm to the reset position shown in fig. 8. This is effected by a reset roller on the ratchet wheel striking the reset lever, which throws the print arm back to the reset position ready for the next letter. The resetting takes place at the blank point on the ratchet wheel and typewheel.

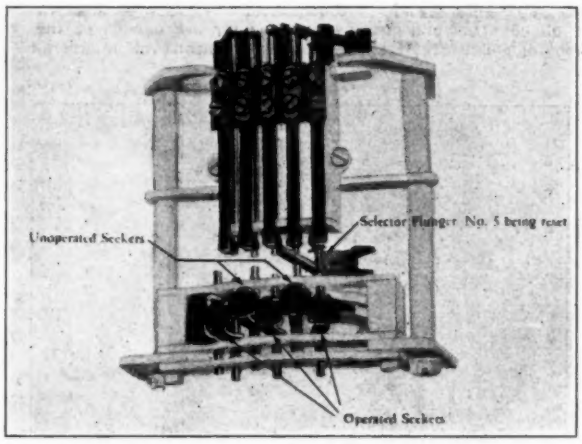

Fig. 5.—Resetting Selector Plungers.

This is the complete chain of operations involved in the recording and printing of a signal and being purely mechanical there is little tendency for it to get out of order; there are no electrical contacts to get dirty.

The teletype is a "start-stop" printer and, therefore, no synchronism is involved, but a starting and stopping clutch takes its place. This is an exceedingly ingenious mechanism for coupling the typewheel shaft of the printer to the motor driving spindle for the period of one revolution of the typewheel. There is also provision for shifting the typewheel slightly back or forward to print letters or figures.

The teletype signals are recorded in type on the tape at both the sending and receiving stations. This "home record" arrangement is not in all cases necessary, and the British Post Office is working the teletypes on a duplex balanced-line without a home record. Of course, each keyboard teletype can send or receive, but receiving teletypes without the keyboard are also employed in certain cases, and keyboard transmitters without the printer are used in some other cases.

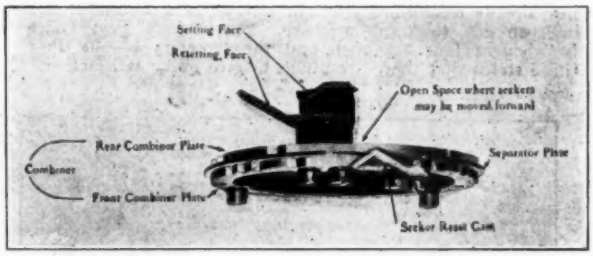

Fig. 6.—Combiner Wheel.

The teletype has been operated successfully on a line between New York and Chicago, 1,000 miles. For such long lines, of course, it is necessary to operate at station A and station B by means of polarised line relays and alternating or "double-current" in the telegraph line. In such cases the teletype is put in a local circuit operating on or being operated by the polarised relay. For moderate distances the teletype will work satisfactorily direct in the telegraph line, about 60 milli-amperes of current being required. The motor is of 1/40th horse-power.

Experience of more than a year under severe traffic conditions has proved that the teletype is remarkably robust

and requires but little maintenance attention. By using copying ink on the typewheel ink-roll, as many as six good copies of messages may be made in a wet-press roller copier.

When secrecy of communication is required, as in the case of wireless working, a fair degree of secrecy exists in consequence of the employment of the five-unit alphabet. When greater secrecy is wanted, it can be readily obtained by changing the speed and the code. The speed of the motor can be set for any rate from, say, 20 to 45 words a minute. Interception of the teletype messages would be extremely difficult without the use of a teletype to interpret them, and if an interceptor used a teletype he would have to set it to the right speed, a difficult task and practically impossible if the sending and receiving teletype speeds are altered from time to time. Even if the interceptor gets the speed right he will still find that the code is wrong, because the arrangement of the five-code or selector bars under the teletype can be changed so as to give a vast number of possible combinations. Interchanging the five bars will give 120 permutations, of which about 60 are useful, and reversing the selector bars end for end combined with the 60 permutations already mentioned will give an immense range of secret codes. For each a different typewheel will be required. If, say in time of war, still greater secrecy is necessary, two or three teletypes, each with a different speed, different code, and different typewheel, would be provided at each station, and messages would be sent on each teletype switched in successively at station A and station B.

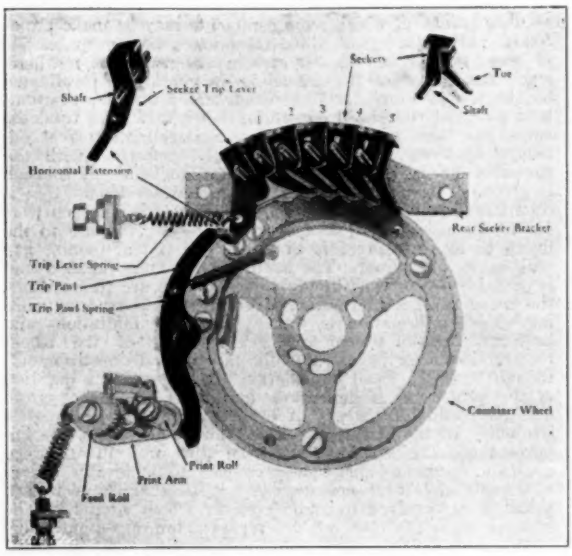

Fig. 7.—Print Arm Before Being Tripped.

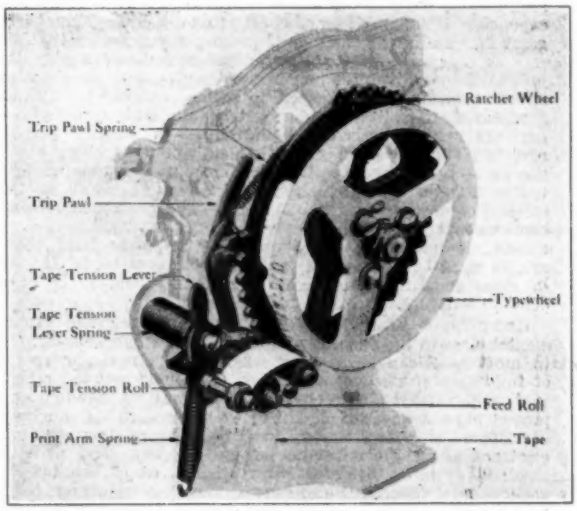

Fig. 8.—Printing Mechanism.

THE RADIO EXHIBITION.

Wireless Convention.

The International Radio Exhibition and Wireless Convention that was held this week at the Central Hall, Westminster, was inaugurated on the 2nd inst. by a luncheon at which Major-General Sir W. B. Brancker, K.C.B., A.F.C., presided. The show was opened by wireless, Sir William's speech being delivered by means of a loud-speaking wireless telephone. It was the first exhibition of its kind to be held in London. Officials were in attendance daily to advise amateurs, and prizes were offered for the best home-made receiving set and for the best invention in connection with wireless appatatus. Two prizes were also offered in a Morse key signalling competition and to illustrate the usefulness of wireless as an aid to the detection and apprehension of criminals, a detective competition was organised, the "wireless effects" produced therein being obtained by means of the dictograph interconversing telephone system of Dictograph Telephones, Ltd.

The exhibition organisers obtained a temporary receiving licence from the Post Office authorities, and demonstrations were given daily. A series of conferences on the following subjects were also arranged: "The Formation of a Wireless Society" (Mr. Geo. Sutton, A.M.I.E.E.); "Long-Distance Wireless" (Capt. Mittell, A.M.I.E.E.); "The Scientific Aspect of Wireless as Distinct from Wireless Technique" (Major Raymond Phillips and Mr. P. J. Risdon); "Automatic Morse and its Future in Wireless" (Mr. A. J. Polley); and "The Use of Wireless in the Home" (Mr. Waring S. Sholl, A.M.I.E.E.).

There were some three dozen exhibitors, whose products consisted chiefly of the various component parts that go to the making of receiving sets and what may be described as "wireless novelties."

Mr. R. Scruby exhibited a complete receiving set with a range of 250 miles, to operate which no previous experience is necessary. The set is enclosed in a Jacobean cabinet, and the diaphragm of the loud-speaker, which is also enclosed in a similar cabinet, is so constructed as to eliminate extraneous metallic sounds as much as possible. The two cabinets make handsome pieces of furniture.

Messrs. Autoveyors, Ltd., showed a two-seater motor-car equipped with a receiver, the aerial of which was incorporated in a sunshade to be held over the operator's head. In addition, the firm had on view "Marconiphones," the Chapmen regenerative static coupling, frame aerials, loud speakers, with components and accessories.

The British L.M. Ericsson Manufacturing Co., Ltd., probably had the best stand in the exhibition, on which were displayed complete receiving sets of various sizes; also telephones and component parts.

Mr. W. J. Henderson, who is more especially interested in wireless control as distinct from wireless telegraphy and telephony, had on view a selection of accessories, accumulators, condensers, transformers, &c.

The City Accumulator Co., as its name implies, exhibited batteries, also headgear, and the "Parliphone" loud-speaker horn that is moulded in one solid piece of ebonite; the base encloses a standard Brown receiver, and no metal is used in its construction.

The following firms, amongst others, were also exhibiting:—

Associated Electric Traders, Ltd., telephone headpieces, small receivers.

Messrs. J. B. Bower & Co., Ltd., crystal and small valve sets; components.

B.N.B. Wireless, Ltd., galena, ganerite, crystal detectors, switches, condensers, &c.

Messrs. Henry J. Brewster & Co., crystal receivers and accessories.

Messrs. J. Bridge & Sons, crystal receiving sets, amplifiers, sets of parts, and accumulators.

The Concordia Electric Wire Co., Ltd., wires and insulating linen, silk, paper, &c.

The Electric Appliance Co., Ltd., wireless instruments and parts.

The Fleet Radio Co., one-valve receiving sets.

Fuller's United Electric Works, Ltd., batteries and accumulators.

Messrs. J. Lipowsky, three-valve receiver and general accessories.

Messrs. James Macintyre & Co., valve and crystal receivers and loud speakers.

Messrs. Pettigrew & Merriman, Ltd., valve and crystal receiving sets, auxiliary apparatus and parts.

The Wireless Exploitation Corporation, crystal and valve sets, frame aerials, &c.

The Consolidated Trading & Manufacturing Co., Ltd., crystal receiving sets.

The Murray Printing Telegraph Systems, "Teletype," a new printing telegraph machine that is described above.

REVIEWS.

Principles of Radio Communication. By J. H. Morecroft. Pp. x+935. Illustrated. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Price 45s. net.

In view of the very extensive literature on wireless communication, the issue of a new work, especially a bulky and expensive volume, requires considerable justification. The great increase in the number of persons interested in the subject as compared with pre-war days may partly supply the justification. Advances and improvements made would also, if of sufficient importance, to some extent justify its appearance. Fortunately, however, Professor Morecroft's book requires neither basis of justification. A cursory perusal reveals its merits and places it on a plane very much above the usual text book expositions. There is a sound practical touch, together with high theoretical attainments in the method of dealing with the subject. The numerous misconceptions that pervade the average wireless text book have been almost, if not quite, sifted out. At the same time there are, it need hardly be said, some criticisms possible, though in some measure these might be generally held to be of a debatable nature.

Exception is taken to the method of treatment of fundamental ideas in the opening paragraphs of the first chapter. As in most American electrical works, the electronic viewpoint of fundamental electric phenomena is adopted and the reader is tacitly invited to accept this viewpoint as having been proved beyond question. Thus a steady current in a circuit of copper wire is definitely stated to be a slow drift of electrons along the substance of the copper. The drift is assumed to be a resultant effect arising out of the heterogeneous motions of free electrons in immense quantities, there being zero drift for zero current and drift proportional to the current and in a direction along the circuit determined by the positive or negative character of the current. Whilst this view of electronic progression in conductors is a great advance on the older hypothesis of high-speed electronic progression, there are many reasons for doubting its validity, or at least, for assuming that if the drift exists it is a secondary or concomitant effect rather than the electric current *per se*. That is, the "electron drift" may be merely an index of a condition determining conductivity in a material, whilst the heterogeneous motions of free electrons constitute the quality of conductivity. On this view the drift would be an aspect of the electronic motions assumed during the passage of a current. A fundamental objection to the previous hypothesis arises from the fact that electric currents are circuital in character; every electric current that flows does so in a complete circuit, having the same strength at every part of the circuit at the same instant even when it is partly conduction and partly displacement current. All currents are, therefore, resolvable into fundamental elements which must also possess the same circuital characteristics. What is there in the idea of an electronic drift which is compatible with a circuital element? The two conceptions do not harmonise. Apart from its highly debatable character, the electronic hypothesis is not necessary in a work on wireless communication. Evidence of this is given by the fact that beyond the very proper reference to electrons in connection with thermionic and kindred devices, they are not again referred to in the later parts of the book where the more advanced wireless theory is dealt with.

It is also a little unfortunate that in the opening paragraph there is a very weak statement to the effect that clouds become intensely electrified by *wind friction* and other causes. A sufficient proof of such a statement would be difficult to find.

One or two of the figures showing distribution of electric field, notably figures 6 and 8, in the first chapter could be improved upon. The equal concentration of charges at the two ends of a rod under the inductive influence of a charged sphere placed near one end, as in fig. 8, conveys an inaccuracy of conception.

The succeeding chapters dealing with the theoretical principles of high-frequency currents and circuits, together with those concerning practical forms of apparatus, are less open to criticism and are good and informative. One point that is usually ignored is well brought out in connection with spark transmitters, *viz.*, that spark resistance is a very erratic and variable quantity, the indications being that the resistance varies widely during one-half cycle of oscillation. To speak of the resistance of a spark or arc as being so many ohms and to base decrement and other calculations on that figure, leads nowhere. Other points of the kind, indicating good practical discrimination, are not wanting. The author has, however, shown himself to the best advantage in the portions dealing with thermionic tubes. That term is not, however, adopted in the book, the devices under that classification being referred to as vacuum tubes, audions, triodes, &c., throughout. If any criticism might be made on the way in which these devices are discussed in their more fundamental aspects, it is that the idea of "space charge" is perhaps rather over elaborated and the simpler idea of electrostatic screening due to conductivity of the electronic stream or the ionised gas, as the case may be, is not conveyed. An important factor in the theory of three electrode tubes, and one which appears to be inadequately appreciated by authors in general, is but slightly touched upon in a footnote on page 384, viz.: the function of the grid in acting as an electrostatic screen on the filament with respect to the plate and the variation of screening power with the changes of grid potential.

Other points on which some comments may be made are as follows: The theory of wave reception given on pages 738 *et seq.*, though carried out at some length, leads nowhere, since the whole of the reasoning is practically invalidated by the footnote on page 739, which states that the solutions hold good only for the *steady state*, that is, after the transient stage has been passed and the maintained stage reached. Seeing that wireless reception is only concerned with the transient stages, it would appear that no sufficient solution is given. This reveals a weakness in wireless theory that is common to practically all text books. The reference on page 314 to quenching of sparks by rotary gaps gives rise to the query as to what proof is available that a lengthening gap will cause quenching. The assumption is not justified and is probably wrong. With regard to Poulsen arc transmitters, the scope of the information given is somewhat disappointing. More information is wanted as to the limitations and best conditions of use of arcs. The theory of the tikker receiver given on page 331 is incomplete and unsatisfactory, though it is the usual explanation. The important question of the protection of generators and other appliances from damage by high-frequency retro-action is not adequately treated. In the matter of wireless direction finders, the important improvement arising from the use of so-called *aperiodic* antennæ loops tightly coupled to a movable coil of a tunable circuit is not discussed. In this connection a principle is involved in radio systems which should not be ignored, since the plan enables separate tuning of individual antennæ to be dispensed with, though they are, in effect, tuned by the agency of the tuned circuit to which they are normally tightly coupled.

A few misprints occur, such as on page 609, fig. 25, where "arcs" should evidently read "cores," and on page 382 "electrodes" for "electrons."

There is, perhaps, a little too much use of photographic illustrations where diagrams or sketches would be more useful; this certainly applies to some of the illustrations of thermionic tubes.

The book covers 919 pages and a very large number of illustrations. As already stated, and in spite of the criticisms made, it certainly forms a very useful addition to wireless literature.—J. E. Taylor.

Protective Relays: their Theory, Design, and Practical Operation. By Victor H. Todd. Pp. xii+274; 244 illustrations. London: McGraw-Hill Book Co. Price 12s. 6d. net.

Mr. Todd introduces his subject by a clear and interesting account of the historical side of the protection of electrical machines and supply networks. He is quite certain that modern relay installations have amply justified the expenditure incurred, and quotes an instance in which the number of supply interruptions was reduced from 25 a year to one per year in this way.

British opinion is divided on this subject. Many engineers are, like Mr. Todd, protective gear enthusiasts, but at least an equal number have the opinion that good mechanical and electrical construction, combined with the simplest possible protective devices or none at all, is a better means of ensuring continuity of supply.

The undoubted importance of the subject should justify the somewhat detailed discussion which follows.

The step from the use of simple fuses to circuit breakers and relays was followed by the introduction of relays which could give more sensitive and accurate settings than was possible with any of the foregoing devices alone. The author is strongly of the opinion that an independent source of supply should be provided for operating trip circuits, and this is quite in accordance with British views.

When dealing with the question of retarded action of relays, he spends most of his time with bellows, oil dash-pot, and magnetic time relays, but does not appear to be acquainted with the pendulum type commonly used in Britain, which is obviously far superior in reliability and accuracy to any of the above-mentioned types.

Power directional relays are described clearly and in close detail, and the alternating-current types should be studied by all who are interested in the subject.

It is interesting to note that Mr. Todd considers that selective relays of this type can give results better than those obtained from any other type of protective gear. This may be true under American conditions, but the reviewer does not think it at all possible for any existing relays to give results at all comparable with those obtained from balanced protective devices such as the split conductor or improved Merz-Price systems.

Important notes of a practical nature and some simple calculations are given of the characteristics of a.c. disturbances, and although there is nothing of a fundamental nature in them, the notes are well worth perusal.

Instruments, transformers and groupings, are dealt with generally, and sufficient information is given about current transformer characteristics to be of considerable assistance to engineers in setting relays accurately.

In a chapter on miscellaneous relays, automatic re-closing relays, and temperature and overload relays of novel types, are dealt with.

A cycle counter for timing relays, breakers, &c., is described, which deserves to be better known.

The testing of current and time settings of relays is dealt with at some length, and the treatment contains much matter of an obvious nature, but the author evidently wishes to emphasize the necessity of taking great pains with details when making tests.

The inaccuracy and unreliability of relays employing leather bellows for introducing time lags are given much prominence with a view to showing the necessity for regular testing and adjustment. The more obvious and economical remedy would be to scrap the type entirely.

The book concludes with an elementary chapter on methods of locating faults on feeders and wiring.

Generally, the book shows up the great differences that exist between American and British practice as regards protective gear. In America, selective relays and graded time limits are relied on to discriminate between faulty and sound pieces of apparatus. The protective installation is comparatively cheap, but requires constant attention from skilled engineers. In Britain, pilot wire or differential systems are preferred. In this case the initial cost is higher, but the subsequent expenses are reduced, and very little skill is necessary except when gear is being installed.

The printing and illustrations are excellent, and the only criticism that can be offered regarding the latter, is that the vector diagrams, fig. 107, are much too small. In spite of many appalling Americanisms, the book can be easily read by anyone who has had an elementary electrical training, and it is heartily recommended by the reviewer.—C.W.M.

Switching Equipment for Power Control. By Stephen Q. Hayes, A.B., E.E. Pp. vi+454; 272 illustrations. London: McGraw-Hill Publishing Co., 1921. Price 20s. net.

The objects of this book as outlined by the author in his preface are: (1) to furnish the actual switchboard operator with information that will help him to keep the equipment in his care in the best operating condition, and to assist him in the selection and installation of new material; (2) to help the student of electrical engineering in a technical school to appreciate how switching equipment ties together the various generators, transformers, feeders, &c. It is also stated that consulting engineers and others will find enough in the theoretical features to give them an understanding of the functions and limitations of the various devices.

A very careful examination of the book by the reviewer revealed many interesting features which are not widely known in Britain, but which appear to be standard American practice. For example, considerable attention is paid to the Schweitzer & Corad products, including carbon tetrachloride fuses and breakers, and automatic reclosing electro-pneumatic breakers. There are also interesting sections dealing with out-door portable and automatic sub-stations. On the whole, however, the treatment is scrappy and superficial, and the reviewer could find no trace whatever of the theory which the author stated in his preface to have been included.

A particularly irritating feature is the repetition of almost identical sections in the same chapter. For instance, in Chapter 12 one section is headed "Rheostat" and two "Rheostats"; practically the same information is contained in them all.

With the exception of the inevitable split infinitives the style is, for the most part, quite clear.

The explanations of the action of a.c. apparatus are very marvellous. For example, on page 237 the action of a polyphase voltage regulator is explained thus:—

"The primary sets up a magnetic flux of constant value, which induces a constant voltage in each of the secondary windings. The induced voltage is added therefore vectorially to the feeder as the cosine of the angle between windings. As the position of the rotor is changed the phase angles between the feeder voltage and the secondary voltage correspondingly changes, and the feeder voltage is either increased or decreased as the phase angle is less or greater than 90 degrees."

The reviewer fails to see how an explanation of this type can be of the slightest value to anyone.

The treatment of balanced protective gear seems very inadequate from a British engineering standpoint, but possibly American views on this subject may differ very widely from ours.

Many minor grammatical or printers' errors occur. For example, page vi, "generator" for "generators"; page 237 "phase-angles . . . changes"; page 293, "curent."

The general production of the book is on the usual high standard of the McGraw-Hill Co., and the numerous excellent diagrams help to counteract the feebleness of the descriptive matter.

Alternating Currents. By C. G. Lamb, M.A. Part I, pp. 73; 61 figs. Price 5s. 6d. net. Part II, pp. 127; 82 figs. Price 7s. 6d. net. London: Cambridge University Press, 1921.

These two paper-covered volumes are in the nature of a series of notes intended for the assistance of third-year students in the engineering laboratories at Cambridge. The treatment is condensed and there are no examples appended, as the author considers that these can best be composed by the lecturer; but in spite of these limitations, there will probably be a considerable circulation for these little books beyond the confines of the Cambridge engineering schools.

Part I treats in the main of what are generally described as the phenomena of a.c. circuits, while Part II deals with alternating-current machinery, the aim being to enable the student to proceed to such works as Miles Walker's "Specification and Design of Electrical Machinery." The author naturally assumes a mathematical, mechanical and physical equipment such as may be expected of a third-year electrical engineering student, and he is therefore able to push on rapidly to such subjects as the vector treatment of transformer imperfections. It must not be thought, however, that the treatment is exclusively mathematical; considerable attention is given to the physical and also the real engineering aspects of the subject; measuring instruments are treated in some detail and a comparatively long section is devoted to the heating and cooling of transformers.

Part II treats very fully of the principles of a.c. generation, commencing with the simple sinusoidal field form and then introducing harmonics and the use of the oscillograph for investigation of wave forms. Polyphase armatures are then considered in detail and the characteristic curves of typical two and three-phase machines are worked out. Motor problems are dealt with vectorially, the circle and "V" diagrams being utilised, and a brief treatment of the rotary converter is also given. Sections on the measurement of power in polyphase circuits and the losses in a.c. machines complete the series of notes.

There can be no doubt that, as aids to the understanding of hastily written lecture notes on a subject in which difficulties both mathematical and physical are met with at every turn, these notes will be invaluable.—P.H.S.K.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

22,041. "Automatic electric sub-station systems." G. A. Cheetham. August 24th.

22,561. "Electric liquid heaters." V. B. Learoyd. August 18th.

22,572. "Electric signalling devices." E. I. David, G. F. Flanders and D. S. Williams. August 18th.

22,573. "Alternating current protective apparatus." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. August 18th.

22,585. "Variable high-tension wireless battery cabinet." J. Flessati and F. W. Sellars. August 19th.

22,591. "Electric gas purifiers." Kirchhoff & Co. and E. Oppen. August 19th. (Belgium, September 16th, 1921.)

22,592. "Electric projection lamps." A. Taylor and H. D. Taylor. August 19th.

22,620. "Magnetic separators." W. Box, A. E. Davies, and H. H. Thompson. August 19th.

22,626. "Method of repairing worn-out electric lamps." A. Jännes. August 19th.

22,631. "Telegraph systems." Automatic Telephone Manufacturing Co., Ltd., and H. H. Harrison. August 19th.

22,648. "Combined gas and electric cooking apparatus." E. C. R. Marks (Salvisbera Fabrik Elektrische Koch-und Heizapparate Salvis). August 19th.

22,651. "Shades for electric incandescent lamps." N. W. Prangnell. August 19th.

22,675. "Electric circuits and switches." G. R. C. White. August 21st.

22,684. "Variable condenser for wireless receiving apparatus." E. T. Chapman. August 21st.

22,696. "Aerials for wireless telegraphy, &c." H. Challis-Sowerby. August 21st.

22,704. "Attachment for sparking plugs." E. B. Gnapp. August 21st.

22,705. "Device for testing sparking plugs." E. B. Gnapp. August 21st

22,717. "Crystal detector for wireless apparatus." H. W. Parker. August 21st.

22,718. "Crystal detector for wireless apparatus." H. W. Parker. August 21st.

22,725. "Generation of electric power from water supplies." J. H. Ewart and J. W. Ewart. August 21st.

22,726. "High-frequency telephone systems." Ges. für Drahtlose Telegraphie. August 21st. (Germany, August 22nd, 1921.)

22,735. "Couplings for electric cables." Felten & Guilleaume Carlswerk Akt. Ges. August 21st. (Germany, August 20th, 1921.)

22,751. "Magnetic separating process for treatment of residues of fuel." Meguin Akt. Ges. and J. H. Leopold. August 21st. (Germany, August 21st, 1921.)

22,754. "Telephonic receivers." R. H. Marriott. August 21st.

22,773. "Methods of reception of wireless telegraphy, &c." E. Y. Robinson. August 22nd.

22,790. "Bush for electric tubing and conduits." R. Wright. August 22nd.

22,830. "Multiple fuse plugs." O. F. Foss. August 22nd.

22,835. "Alternating-current dynamo-electric machines." L. J. Hunt and Sandycroft, Ltd. August 22nd.

22,836. "Alternating-current dynamo-electric machines." L. J. Hunt and Sandycroft, Ltd. August 22nd.

22,837. "Alternating-current dynamo-electric machines." L. J. Hunt and Sandycroft, Ltd. August 22nd.

22,839. "Electric lamps." J. W. Pautriero. August 22nd.

22,850. "Electro-magnetic transmission mechanisms." A. H. Stevens (C. E. F. Ahlm). August 22nd.

22,851. "Controlling system for electro-magnetic transmission mechanism." C. E. F. Ahlm. August 22nd.

22,859. "Electrolytic apparatus and method of depolarising same." W. D. Nickum. August 22nd.

22,865. "Wireless receiving apparatus." C. H. Collins. August 22nd.

22,869. "Automatic switching apparatus for electric distribution systems." British Thomson-Houston Co., Ltd. (General Electric Co.). August 22nd.

22,871. "Steam-reheating apparatus." Electrical Improvements, Ltd. August 22nd.

22,876. "Electric switches." A. Green. August 22nd.

22,885. "Connecting device for radio receiving systems." W. Dubilier. August 22nd. (United States, May 23rd.)

22,890. "Sparking plugs." A. G. Brown. August 22nd.

22,902. "Miners' electric safety lamps." J. T. Jackson. August 23rd.

22,903. "Miners' electric safety lamps." J. T. Jackson. August 23rd.

22,937. "Telephone scribbling-block holder." C. H. J. Harvey. August 23rd.

22,939. "Sparking gap device." A. Shuttleworth. August 23rd.

22,943. "Sparking plugs." S. G. Ransley and H. E. Sexton. August 23rd.

22,964. "Sparking plugs." W. E. Ricketts. August 23rd.

22,967. "Production of electrical discharges in vacuum tubes." C. Degnisne and F. Dessauer. August 23rd.

22,971. "Electric generators." F. Westwood. August 24th.

22,976. "Condensers for wireless telephonic and telegraphic apparatus." R. S. Woods. August 24th.

23,008. "Electric burglar, &c., alarms." E. R. Smith. August 24th.

23,015. "Radio telephonic and telegraphic receiving and transmitting station." A. Perego. August 24th. (Italy, August 25th, 1921.)

23,020. "Electrically-heated soldering irons." C. R. Riber and Siemens Bros. & Co., Ltd. August 24th.

23,023. "Wireless transmission by thermionic vacuum tubes." E. J. Grainger, L. G. Preston, and G. Shearing. August 24th.

23,024. "Generation of high-frequency alternating currents." L. G. Preston and N. Shuttleworth. August 24th.

23,028. "Switching for tuning wireless receiving sets." E. E. Moore. August 24th.

23,029. "Lightning protector for wireless receiving sets." E. E. Moore. August 24th.

23,030. "Fixed condensers having small valves of capacity." E. E. Moore. August 24th.

23,034. "Electric heaters." British Thomson-Houston Co., Ltd. August 24th. (United States, August 24th, 1921.)

23,035. "Motor control systems." British Thomson-Houston Co., Ltd., H. Breghorn, and H. F. Farmer. August 24th.

23,041. "Automatic electric sub-station systems." Metropolitan-Vickers Electrical Co., Ltd. August 24th.

23,046. "Holders for incandescent electric lamps." A. M. Carey. August 24th.

23,059. "Rectifying devices." A. R. Angus. August 24th.

23,062. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. August 24th. (United States, October 11th, 1921.)

23,070. "Head lamps for motor vehicles." F. E. Musgrave. August 24th.

23,081. "Illuminated number-board signal and rear light for motor cars, &c." M. Woodward. August 25th.

23,104. "Rail joints for tramways, &c." H. Littlewood. August 25th.

23,108. "Variable inductances." J. H. Reyner. August 25th.

23,111. "Sparking plugs." F. J. Mills and G. H. Ward. August 25th.

23,112. "Electric resistances." Crompton & Co., Ltd., and W. F. Jones. August 25th.

23,113. "Electric resistances." Crompton & Co., Ltd., and W. F. Jones. August 25th.

23,114. "Electric rheostats." Crompton & Co., Ltd., and W. F. Jones. August 25th.

23,115. "Electrical instrument cases." Crompton & Co., Ltd., W. F. Jones and W. G. Smith. August 25th.

23,125. "Electric striking and chiming apparatus." A. G. Elam and M. Sanders. August 25th.

23,138. "Telephonic receivers, &c." A. J. Henderson. August 25th.

23,141. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). August 25th.

23,142. "Systems of electric control." British Thomson-Houston Co., Ltd. (General Electric Co.). August 25th.

23,166. "Automatic circuit-breaking device." E. Johnson. August 25th.

23,175. "Brakes for tramway vehicles." G. H. Read and H. Read. August 26th.

23,196. "Electric hand lanterns." J. Eaton and Efandem Co., Ltd. August 26th.

23,216. "Electrically-operated change-speed gear." C. Ter Cock. August 26th.

23,220. "Brackets for electric fans, &c." M. J. Railing and C. W. Saunders. August 26th.

23,233. "Thermionic valves." C. H. Burgess and J. Gray. August 26th.

23,234. "Thermionic valves." British Thomson-Houston Co., Ltd., C. H. Burgess and J. Gray. August 26th.

23,235. "Pneumatically-operated controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). August 26th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

3,927. "Automatic exchange telephone system." H. Baron (F. Aldendorff). February 2nd, 1921. (Cognate applications, 4,777/21 and 7,884/21.) (184,200.)

4,178. "Method of and means for registering telephone calls." E. H. Kinnard and W. Clark. February 4th, 1921. (Cognate applications, 6,528/21, 10,179/21, and 19,914/21.) (184,202.)

5,001. "Coils for electrical transformers." British Electric Transformer Co., Ltd., and J. Roothaan. February 12th, 1921. (184,207.)

9,185. "Employment and production of polyphase currents for wireless telegraphy, telephony, or other purposes." J. H. Whittaker-Swinton. March 24th, 1921. (184,216.)

9,491. "Electric drive for vehicles." E. C. R. Marks (Soc. Anon. Construction Electriques de Belgique)). March 30th, 1921. (184,219.)

9,721. "Electric heaters." Cutler-Hammer Manufacturing Co. June 22nd, 1920. (165,443.)

9,952. "Automatic electric circuit breakers." Metallurgique Electrique. September 6th, 1920. (168,849.)

12,213. "Sound amplifiers for gramophones and phonographs." T. W. Price. April 28th, 1921. (184,234.)

12,406. "Sealing of leading-in wires for electric incandescent lamps and for similar purposes." W. P. Thompson (Vereinigte Glühlampen und Elektrizitäts Akt. Ges.). April 30th, 1921. (184,238.)

12,450. "Electrical means for operating or controlling mechanisms by sound." C. P. Ryan. April 30th, 1921. (184,239.)

12,454. "Electric radiators." J. R. Quain and H. Harrison. April 30th, 1921. (184,240.)

12,573. "Process for the electrolytic production of potassium bi-carbonate from potassium chloride solutions." Chemische Fabrik Briesheim-Elektron and Dr. R. Suchy. May 2nd, 1921. (184,244.)

12,654. "Telephone exchange systems." Western Electric Co., Ltd., and L. Polinkowsky. May 3rd, 1921. (184,249.)

12,922. "Apparatus for converting alternating electric currents to direct currents and *vice versa*." J. E. Calverley and W. E. Highfield. May 5th, 1921. (184,259.)

12,935. "Electrical plug switches and the like." E. Jones. May 6th, 1921. (Addition to 159,618.) (184,260.)

13,010. "Manufacture of drawn tungsten wires." Patent Treuhand Ges. für Elektrische Glühlampen. May 7th, 1920. (163,014.)

13,427. "Regulating systems for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 11th, 1921. (184,278.)

13,467. "Device or apparatus for recording and checking telephone calls." W. C. Sutherland, J. G. Sutherland, C. W. Cooke, J. E. Copeland, and W. Rogers. May 12th, 1921. (184,280.)

13,514. "Quartz mercury vapour lamps." Quarzlampen Ges. June 17th, 1920. (165,081.)

13,566. "Methods of controlling the relative phases of alternating currents, especially applicable to wireless signalling." W. H. Eccles. May 13th, 1921. (184,282.)

13,654. "Operating handles for electric switches or like devices." W. J. Mellersh-Jackson. (Appareillage Gardy Soc. Anon.). May 13th, 1921. (184,283.)

14,144. "Incandescent electric lamps and the like." O. Oberlander and W. H. Le Marechal. May 20th, 1921. (184,291.)

14,695. "Electric safety lamp for miners." L. A. Didier. August 17th, 1920. (168,038.)

14,918. "Electric glow lamps." R. L. Woosnam. May 30th, 1921. (184,302.)

15,532. "Electric heating elements." H. W. Sullivan and C. B. Gresham. June 4th, 1921. (184,307.)

15,917. "Piezo electric devices." E. W. C. Russell and A. F. R. Cotton. June 9th, 1921. (Cognate application 8,066/22.) (184,314.)

17,727. "Cut-out for electric circuits." Bayerische Elektrizitats-Industrie Rott & Co. July 15th, 1920. (166,523.)

17,784. "Electric accumulators." C. J. J. L. De Vos. June 30th, 1921. (184,336.)

17,801. "Electrical commutators or distributors." G. H. Jackson. June 30th, 1921. (184,337.)

18,226. "Induction electric motors." G. H. Fletcher and Metropolitan-Vickers Electrical Co., Ltd. July 5th, 1921. (184,340.)

19,636. "Electric couplings." A. L. Davis. July 21st, 1921. (184,354.)

19,650. "Device for maintaining a constant voltage in variable-speed dynamos." A. H. Traeger. July 21st, 1921. (184,355.)

20,281. "Terminals or connections for use in electric circuits." H. Lucas and W. H. Egginton. July 28th, 1921. (184,362.)

20,761. "Electric switches." C. L. I. Manufacturing Co., Ltd., and E. A. Watson. August 4th, 1921. (184,367.)

20,990. "Means for making watertight connection between cables and switch junction boxes or other fittings in electric wiring systems." M. J. Railing, F. G. Quance, and H. V. Owen. August 8th, 1921. (184,369.)

21,871. "Electric clutch coupling for use in dental technics." E. Huet. November 20th, 1920. (171,969.)

22,273. "Systems for wireless tranmission of writing, pictures, and the like." M. H. Petersen. September 9th, 1920. (168,876.)

1922.

1922.

5,791. "Push-button electric switches." T. E. D. Bilde. March 21st, 1921. (177,500.)

14,906. "Protective devices for electric circuits." British Thomson-Houston Co., Ltd. May 26th, 1921. (180,694.)

New York's Fire Alarm System.—The new fire alarm system of New York City has been completed and is now in use. The work was started in 1904 and the plans were finally completed in 1914. The new system has cost the city $1,750,000, and the Empire City Subway Co. has spent $1,200,000 for additional ducts to carry the wires under its contract. The central station of the system is in Central Park.—*T. & T. Age.*